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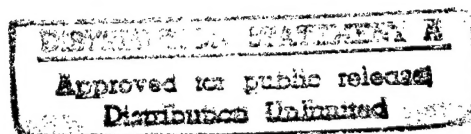Broadcast
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'Svecha-4' All-Weather Airport Lighting System

*917K0227A Moscow SVETOTEKHNIKA in Russian
No 1, Jan 91 pp 4-8*

[Article by Yu. G. Basov, S. I. Mayzenberg, Elektroluch Scientific Production Association and Special Lighting and Signaling Device Design Office, Moscow]

UDC 628.971.8:656.71

[Abstract] Issues involved in equipping ICAO categories I, II, and III airports with light-signal devices in order to increase flight safety under all weather conditions and increase the civil aviation traffic are summarized. The first domestic light-signal complex - "Svecha-4" - developed for all three airport categories by the light-signal device special design office in 1979 is described. It is distinguished from its predecessor (Svecha-3) by a greater number and diversity of the sight-signal equipment used. Specific types of fixtures used in the Svecha-4 system for runway (VPP) contact lights, approach lights, and taxiway (RD) lights are described and a Svecha-4 position layout is presented. Runway lights are arranged according to the precision approach path indicator (PAPI) principle. Characteristics of the instrument landing system (ILS) classes used in civilian airports are summarized. The Svecha-4 complex meets ICAO failure-free operation requirements; if one of the main power supply system fails, the interruption does not exceed 1 s. The TMA-4 remote control equipment for managing the system is described. The complex is undergoing state flight tests at one of the country's civil aviation airports. Ye.I. Knyazev, S.V. Kirillina, A.K. Yutsevich, A.D. Borisov, L.N. Latysheva, V.P. Berestov, as well as designers and engineers from the special design office and the Ministry of Electrical Engineering Instruments participated in developing the Svecha-4 complex. References 9; figures 5; tables 1.

New TV Colorimeter

*917K0227B Moscow SVETOTEKHNIKA in Russian
No 1, Jan 91 pp 8-10*

[Article by I. G. Aleksandrova, Moscow Television Scientific Research Institute]

UDC 535.6

[Abstract] The new KFT-1 television colorimeter developed jointly by the Moscow Television Scientific Research Institute, VNIIOFI, and the Neytrino Central Design Office is described. It is an integrated digital photoelectric instrument based on the simultaneous operation principle. It contains three silicon photodiodes used as photodetectors. The colorimeter block-diagram is presented. The KFT-1 has the following metrological characteristics: a 0.005 chromaticity coordinate measurement error in the standard 1931 CIE system; a 0.0005 RMS error (SKO) of measurement results; a minimum picture tube screen white glow intensity sufficient for measuring the chromaticity coordinates within an established error of 10 cd/m^2; for primary colors, the same measurement conditions exists at an intensity of about 6, 10, and 1 cd/m^2 for red, green, and blue, respectively; a measured picture tube screen diameter of 50 and 20 mm; a measurement duration of no more than three s; and a brightness measurement error within the 1-1,000 cd/m^2 range of no more than 10 percent. The KFT-1 operating algorithm is described and its block-diagram is presented. The colorimeter is capable of calibrating four colors in a digital form simultaneously. Today, colorimeter prototypes are undergoing pilot and commercial tests. References 4; figures 2.

'Marathon'

*917K0231A Moscow RADIO in Russian No 11, Nov 90
pp 6-8*

[Article by A. Radimov, D. Mikolenko, Astra Scientific Production Association]

[Abstract] A new computer-aided system for satellite communication with mobile and remote objects soon to be deployed in the USSR - the Marathon - is described. The emergence of one of the largest undertakings in the field of communications reflects the urgent need of the national economy and primarily the transportation industry, especially in underdeveloped remote areas, for expanding information interchange capabilities. System users will have the following services available at all times: duplex telegraph/telex; simplex telegraph/telex; duplex or simplex telephone; switched data transmission with relaying or storage at 300 and 600 bit/s rates; and circular polling (group, individual, and area-wide); the equipment will also make it possible to set up a digital duplex or simplex high-fidelity telephone channel capable of data or facsimile transmission at 3,400, 4,800, and 9,600 bit/s and data exchange at a 16,000 bit/s rate with a possibility of accessing ISDN's. In addition, an information security system will be available for some users. The system (consisting of a space segment and a terrestrial network) will cover 150,000 subscriber units at various parts of the globe. The Arkos repeater satellites with active phases antenna arrays (AFAR) will be used in the space segment. In addition, the Marathon system will service the Sadko-M emergency warning system equipped with radio buoys. Pursuant to a ministerial-level decision, the Astra Scientific Production Association will be responsible for developing and implementing the system. Figures 3.

Electronic Mail

*917K0231B Moscow RADIO in Russian No 11, Nov 90
pp 9-12*

[Article by G. Ivanov, Moscow]

[Abstract] The design principle of electronic mail and its three basic components - a workstation connected by a modem to a switched telephone line, a local or regional electronic mail system developed on the basis of a rather powerful computer capable of servicing several users simultaneously, and a data transmission network which facilitates "message exchange" among regional nodes - are explained. The regional electronic mail system serves as a local "post office" where users maintain "mail boxes" and as a node of the regional electronic system network. It is shown that virtually any word processing software can be used for electronic mail. Various electronic mail systems

and protocols currently used throughout the world and in the USSR (e.g., the Compuserve and its amateur radio component - the HamNet) are described and their operating procedures are explained. The packet switching data transmission network which links all national electronic mail networks is presented. The operation of bulletin board systems (BBS) is outlined. In the USSR, RK3KP, RS3A, and UZ3AXO ham radio stations are already proving BBS services. Figures 2; tables 1.

Ham Radio 'Telephone'

917K0231C Moscow RADIO in Russian No 11, Nov 90 pp 24-30

[Article by V. Besedin (UA9LAQ), Tyumen]

[Abstract] Continued from *Radio* No. 10, 1990. Specific design features of the ham radio telephone transceiver are summarized. The design of the equalizer, microphone amplifier-limiter, transmitter driver, low-pass filter (FNCh), antenna relay, and power supply unit are described in detail. Specifications of all resistors, capacitors, transistors, and coils are cited. A commercial PSK station crystal filter is used. Procedures for tuning and adjusting transceiver elements and trimming its capacitors are described. The transceiver is designed for operating at a single fixed frequency in order to ensure instant selection of preset users - members of a ham group. It is expected that in future the frequency channel could be used as a call circuit and that frequency could be tuned in 25 kHz steps by means of switching crystal vibrators together with trimming capacitors. The transmitter bandpass makes it possible to change the output signal frequency within +/-100 kHz without a noticeable degradation of its parameters. In order to change the reception frequency, several identical crystal oscillators are required. Vibrators with a frequency in the 12,105-12,194 MHz band prior to trimming were used in the transmitter. References 2; figures 7; tables 1.

Individual Modular Receiver Unit

917K0231D Moscow RADIO in Russian No 11, Nov 90 pp 37-41

[Article by S. Sotnikov, Moscow]

[Abstract] Factors which constrain the implementation of satellite to home television systems in the USSR are reviewed. The author's experience in directly receiving TV programs beamed by various European satellites (Orbital Test Satellite launched by ESA, CTS Hermes, ESC F1 and F2, and Intelsat) and their equivalent isotropically radiated power (EIIR), noise factor, and operating frequencies (in the 11 and 12 GHz bands) are described. Operation of individual satellite TV reception units since the start of multichannel broadcasting in the 11 and 12 GHz bands is summarized. Because the receiving equipment contains microwave (SVCh) devices and elements and is based on methods of transmitting and receiving low-power FM (ChM) video signals over a distance of about 40,000 km, the design of certain essential components which are generally not used in "terrestrial" TV is described in greater detail. It is emphasized that said devices do not contain scarce or expensive parts or elements but contain commercial 3 cm band modules; the tuners are made from commercial TV units and modules. References 15: 12 Russian, 3 Western; figures 4.

Adaptive Weighting in Problem of Digital Sound Signal Compression

917K0218A Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 33 No 12, Dec 90 pp 7-12

[Article by A. A. Berestetskiy, O. A. Klimova, A. M. Sinelnikov]

[Abstract] Spectral region coding - one of the most efficient methods of compressing a digital sound signal (ZS) - is considered; here the spectrum is understood as a product of orthogonal transformation of the initial digital signal sample blocks. The effect of weighting on the correlation of spectral components is analyzed; a correlation decrease, in turn, leads to a decrease in the reconstruction's RMS error. Al algorithm which makes it possible to decrease the RMS error of reconstruction by sampling the window function is proposed. The results of a computer experiment with real sound are presented. The proposed algorithm based on adaptive window function sampling makes it possible to decrease the signal recovery error in the receiver by 20 percent; given a 40-60 dB mean noise level in real equipment, such a recovery error decrease corresponds to an 8-12 dB increase in the signal/noise ratio. References 6: 5 Russian, 1 Western; figures 6.

Equalization in Multimode Digital Optic Communication Systems

917K0218B Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 33 No 12, Dec 90 pp 12-16

[Article by A. M. Itkin]

[Abstract] An optimal (with respect to minimum mean square error (SKO)) receiver for a more general model of photocounting, whose design is based on Wiener's method of modeling dynamic systems on the basis of the theory of functionals, is examined. An equalization method applicable to digital optic communication systems operating in the current measurement and photon counting mode is suggested on the basis of orthogonal Poisson process functionals. As a result, an optimal receiver is synthesized and its minimum mean square error is determined; the results are consistent with known data. Simulation data on an atmospheric channel with multiple forward scattering at a 400 Mbit/s rate are cited. It is demonstrated that given data transmission at the above rate, the aforementioned equalization method makes it possible almost to double the attainable optical depth or, in the case of a fixed effective scattering coefficient, increase the distance between the users by the same amount with no detriment to noise immunity. References 7: 2 Russian, 5 Western; figures 2.

Trajectory Parameter Filtering in Goniometric Doppler Locator Systems

917K0218C Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 33 No 12, Dec 90 pp 22-26

[Article by Yu. G. Bulychev, A. A. Korotun, A. P. Manin]

[Abstract] A method of locating a target and estimating its parameters in a single-point goniometric Doppler system (UDC) which is free of cumulative range calculation errors inherent in traditional passive location methods is considered. Analytical slant range expressions are derived from the results of goniometric Doppler locator measurements on the basis of piecewise linear target motion model invariants. These expressions make it possible to manage the process of optimal linear filtering of the complete target state vector on the basis of incomplete UDC measurement vector data. The method efficiency is especially high in modern radio engineering systems where high angle, angular velocity, and acceleration resolution is attained due to a transition to shorter wavelengths and antennas with a larger aperture; under such conditions the method is preferable to the traditional approach to computing range in passive Doppler systems based on integrating the radial velocity allowing for *a priori* known initial conditions. References 4; figures 1.

Estimating RF Radiation Source Position Based on Filters With Preselection of Observations

917K0218D Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 33 No 12, Dec 90 pp 26-30

[Article by A. A. Sirota]

[Abstract] Linear and expanded (nonlinear) dynamic filtering algorithms optimized by their preprocessing data (PO) in *a priori* dynamic strobes (DS) are derived allowing for the characteristic features of the interfering observation data input. The filters are synthesized in discrete time whereby each step in filtering equations corresponds either to the next PO time cycle if the target position is estimated by one moving receiver or to the next space-distributed system receiver which transmits preprocessed observation data. The resulting algorithms are analyzed using the example of a known problem of locating the position of a fixed radiator by means of a moving receiver using the multiple direction-finding method. It is shown that given a low unit value probability, the characteristics of linearized and expanded algorithms virtually coincide while in the case of high probabilities the latter ensures a higher position-finding accuracy; then the linearized filter's deviation of real characteristics from theoretical is attributed to first approximation errors. References 4; figures 1.

Multiple Target State Measurement Identification With Parametric Uncertainty of Motion and Measurement Models

[Article by V. A. Zaytsev, A. V. Ekalo]

UDC 621.391:62-501

[Abstract] The task of identifying measurements while tracking several targets under conditions of parametric uncertainty of motion and measurement models in the presence of several interfering parameters is solved. To this end, a recursive algorithm for calculating the identification functional and a method of its decomposition are proposed. The algorithms' structure and resource requirements are discussed. The problem's applications to the task of tracking a dense group of moving targets by data of a surveillance radar (RLS) under the conditions of *a priori* parametric uncertainty are considered. The algorithm thus synthesized permits efficient parallelization of calculations whereby the total computation volume is comparatively small and proportionate only to the first power of the number of tracked targets. References 3.

Bandpass Transmission of Microwave Signals in System of Orthogonal Magnetostatic Waves' Antennas

[Article by I. V. Zavislyak, V. V. Zagorodniy]

UDC 621.372.8.049:538.566

[Abstract] Functional microwave (SVCh) devices based on magnetostatic waves (MSV) in yttrium iron garnet (ZhIG) films, particularly systems which ensure bandpass transmission of microwave signals, are considered. Special measures which must be taken in such devices to eliminate output noise induced by the input and the amplitude-frequency response curve jaggedness due to the magnetostatic wave reflection and higher mode generation are discussed. A system consisting of a right triangular epitaxial 36.7 µm-thick YIG film with 5.6 and 8 mm sides was examined; the transmitting and receiving MSV antennas were positioned along these sides. Transducers were applied to a 0.5 mm-thick polikor substrate. YIG films were magnetized by a 52,400-58,000 A/m field tangential to its surface created by a permanent magnet. The field orientation in the film plane was manipulated from 0 to 360°. As a result of the studies, the system's bandpass was estimated and the effect of magnetic anisotropy, particularly the participation of anisotropic forward MSV's along with surface MSV's (PMSV) in the energy transport, was correctly taken into account. It is shown that this bandpass system is small in size and has good off-band signal suppression characteristics. References 4: 2 Russian, 2 Western; figures 2.

Structural Element Specifications of Bandpass Microwave Filters

[Article by M. Ye. Ilchenko, A. V. Zakharov]

UDC 621.372.543

[Abstract] Development of bandpass filters (PPF) with given transmission band (PP) and attenuation pole distributions, particularly bandpass filters with a considerable mutual spacing of the fundamental and first spurious PP's, is considered. A bandpass filter consisting of transmission line sections which contains parallel resonators connected by coupling circuits is examined. Losses in the filter's structural elements are regarded to be negligible. An attempt is made to define the coupling circuits in such a way so as to ensure that the filter's bandpasses are the same as those of a filter with inverters. To this end, a balanced PPF with three resonators whose coupling circuits are bilateral networks with a transmission matrix which meets the reciprocity condition is considered. As a result, specifications of the bandpass filter's structural elements are formulated for parallel and serial resonators, making it possible to expand the possibilities of synthesizing filters with diverse amplitude-frequency responses. References 3; figures 4.

Wide-Band Multisection Optoelectric Modulators

[Article by A. V. Kosarev, Yu. G. Neykov]

UDC 621.372.826

[Abstract] Factors which limit the transmission band of optoelectric modulators (EOM), e.g., the difference in phase velocities of the optical and SHF (SVCh) waves, and their shortcomings are addressed. A method of expanding the bandwidth of integral optical EOM's is considered. A very simple phase modulator consisting of rectilinear optical fiber section and a system of coplanar electrodes which are formed on an electrooptical crystal substrate (e.g., lithium niobate $LiNbO_3$) is examined. The electrodes are sections of equal length which operate into matched loads and are spaced by gaps. It is shown that the above method's shortcoming is the complication of the power supply circuit; the method may also be used to increase the speed of response of a directional coupler-based (NO) modulator with coupled optical fibers. It is established that bandwidth of the multisection EOM's with phased sections increases in proportion to their number whereby a positive effect is attained without increasing the modulating signal power. These types of EOM's may find applications in high-speed digital fiber optic transmission lines (VOSP) and high-resolution pulsed optical reflectometry. References 4: 1 Russian, 3 Western; figures 2.

Noise Immunity of Generalized Spectral Signal Processing

[Article by Yu. F. Uryadnikov]

UDC 621.396.96:621.391.26

[Abstract] Various noise suppression systems, e.g., wide-band limiters with a matched filter (ShO-SF), narrow-band noise protection unit with a matched filter (BZ-SF), wide-band filter, limiter, and narrow-band filter (ShOU), etc., are summarized in the form of a generalized spectral processing (OSO) algorithm on the basis of the linear signal representation reciprocity. To this end, a case where an additive mixture of a known type of signal and one interference is present on the receiver input is considered. An algorithm of generalized spectral processing of the mixture which makes it possible to suppress the interference efficiently, provided the signal/noise ratio is much greater than unity, is determined. The above algorithm generalizes various known systems of noise-immune detection of composite signals through strong interference and makes it possible universally to suppress a complex of noises by using a set of basis functions whereby the noise suppression quality corresponds to the efficiency of known receiver protection systems under similar conditions. References 2.

Potential Efficiency Estimation of Space-Time Signal Processing in Mobile Communication Lines With Pseudorandom Operating Frequency Hopping

[Article by Ye. I. Glushankov, A. N. Kolesnikov]

UDC 621.396.67

[Abstract] It is shown that the necessary noise immunity of radio communication links with mobile objects can be ensured by comprehensively using various methods; of these, the space-time signal processing (PVOS) and use of signals with pseudorandom operating frequency hopping (PPRCh) are the best. Potential efficiency of a combination of PVOS and PPRCh which is estimated by the results of solving Wiener's-Hopf's equation for narrow-band processing of signals with PPRCh within the entire frequency hopping range, for wide-band signal processing with PPRCh by using a multiple tap delay line (MOLZ) on the output of each antenna element (AE), for wide-band signal processing with PPRCh performed by subdividing the entire frequency hopping range into a series of bands within each of which the narrow-band requirement is met, and for high-speed narrow-band PVOS performed at each frequency position is analyzed. In so doing, the fact that the PVOS efficiency decreases due to scattering properties of the antenna array (AR) because the boresight depends on the excited oscillations frequency resulting in the so-called aperture effect was taken into account in each version. Efficiency was analyzed by simulation on an SM-1420 computer (EVM). Several methods of eliminating the aperture effect are considered. References 3; figures 2.

Experimental Investigation of Spectral Characteristics of Coherent Signals Reflected From Vegetation in Shorter Wave Range of Millimeter Band

[Article by V. S. Korostelev, G. I. Khlopov, V. P. Shesto-palov, Radiophysics and Electronics Institute at the Ukrainian Academy of Sciences]

UDC 621.371.3,029.65

[Abstract] The results of an experimental investigation of Doppler spectra of 2 mm band echo signals from grass, bushes, single trees, and forest edge along near-earth paths are cited. A coherent instrumentation radar (RLS) was used in measurements; its operation is based on a diffraction radiation generator whose parameters make it possible considerably to lower the noise factor of the locator receiver in the Doppler frequency band compared to other types of generators. It is shown that the principal echo signal energy is concentrated in the frequency range under 100 Hz. It is noted that compared to longer wave bands, the echo signal spectrum shape is characterized by a greater rectangularity; during wind gusts, a pedestal appears in the spectrum at the -(30-40) dB level which is probably due to an amplitude modulation of the echo signal spectrum by moving leaves; the spectrum width largely depends on the wind bearing relative to the path; and the principal contribution to the coherent echo signal spectrum in the shorter wave range of the millimeter band (KVCh MMD) is made phenomena related to the Doppler frequency modulation. References 11: 10 Russian, 1 Western; figures 4; tables 2.

Selective Polarization Wave Excitation in Ionospheric Communication Channel

[Article by L. N. Arefyeva, Yu. V. Berezin]

UDC 621.391:550.388

[Abstract] The problem of the effect of the incident and characteristic wave matching quality on the reception noise immunity of data transmitted over an ionospheric communication channel is solved. It is difficult to attain an accurate matching of the incident field polarization with the polarization of one of the characteristic waves in real ionospheric radio paths; consequently, the possibility of increasing the data transmission noise immunity by means of selectively exciting only one characteristic wave is considered. The results attest that selective excitation of one characteristic wave in the ionosphere on the basis of polarization matching of the incident and excited waves is an efficient means of improving the noise immunity of data transmission over an ionospheric communication channel. The requirements imposed on the matching quality are determined by the permissible degradation of reception quality and may be estimated on the basis of the above results in each specific case. The use of this method makes it possible to eliminate fading due to interference of the ordinary and extraordinary components of randomly polarized waves emitted by the antenna. References 3: 2 Russian, 1 Western; figures 2.

Amplitude- and Phase-Frequency Characteristics of Vertical Incidence Sounding of Magnetoactive Ionosphere

[Article by V. Ye. Kunitsyn, A. B. Usachev]

UDC 537.874

[Abstract] To examine the magnetoactive ionosphere, a method is proposed for calculating the complex reflectance of a random magnetoactive ionospheric layer in the case of vertical incidence sounding. The method is an extension to the case of anisotropic magnetoactive ionosphere of a method of computing the complex reflectance of random electron concentration profile and effective ionosphere collision frequency in an isotropic atmosphere approximation. An algorithm for calculating the amplitude and phase of radio waves reflected by the stratified magnetoactive ionosphere with a random electron concentration and effective collision frequency is proposed. The proposed method of computing amplitude-frequency and phase-frequency characteristics of vertical incidence sounding of magnetoactive ionosphere makes it possible to analyze the distortion of radio pulses due to reflection from real ionospheric layers allowing for wave phenomena and absorption which is important for practical tasks of remote sensing of the ionosphere and radio communication. Reflection from a parabolic 2 km-thick electron concentration profile with the maximum electron concentration

of 3.1×10^5 cm^{-3}, given a constant effective collision frequency within the layer of 4×10^{-4}, is calculation for illustration. References 6; figures 2.

Method of Increasing Noise Immunity of Digital Data Transmission Radio Channel

[Article by D. Ye. Matveyev]

UDC 621.396:621.396.62

[Abstract] The noise immunity (PU) of a radio channel using frequency shift keyed (ChMn) signals with a low PSK index and continuous phase whereby a second intermediate frequency (PCh) amplifier is used in the receiver in order to increase the path's signal/noise ratio is analyzed. It is assumed that the IF amplifier, band-pass filer (PF), and frequency discriminator (ChD) tuning center frequency is the same as the signal carrier and that the frequency discriminator's amplitude-frequency response is linear within the signal band. Signal and fluctuation noise transmission in the receiver section given a signal/noise ratio much greater than unity is considered. It is shown that for a channel with a low PSK index, an increase in the signal/noise ratio in proportion to the square of the frequency countdown ratio in the second IF receiver circuit ensures an error probability of 1×10^{-6} given a 6 dB signal/noise ratio on the receiver input. As the number of parametric frequency dividers (PDCh) in the second IF circuit increases, noise immunity increases insignificantly. Signal detection errors are due to the appearance of abnormal input components on the receiver output when the signal/noise ratio on the receiver input approaches the 3 dB level. References 6: 5 Russian, 1 Western; figures 3.

Kalman Filtering With System Parameter Variations

[Article by S. V. Sokolov, V. M. Matyukhov]

UDC 525.7

[Abstract] The problem of optimal estimation of the disturbed Kalman filter's error vector is considered. It is shown that existing approaches do not make it possible to estimate the disturbed filter error at each filtering process step; at best, the error's upper bound is determined, which may not be regarded to be the solution of the stated problem. A two-stage solution of the problem of disturbed Kalman filtering is proposed: preliminary derivation of the disturbed estimation and a posteriori variance stochastic error vectors as well as the true estimate vector model followed by a joint estimation of the resulting vectors by using the conditional Gaussian filtering methods. It is demonstrated that the estimate of such an expanded vector made on the basis of this method is optimal. Both a disturbed Kalman estimate and the signal of the object position finder can be used as the observation signal in the estimation equation. References 5; figures 1.

Modified Posner Algorithm Efficiency Estimation in Tasks of Wide-Band Signal Search by Delay

917K0228E Moscow RADIOTEKHNIKA in Russian No 1, Jan 91 pp 39-42

[Article by V. I. Zhuravlev, R. A. Knyazev, N. N. Kravchenko]

UDC 612.396.946

[Abstract] Posner's two-stage method of searching for wide-band signals (ShPS) by the delay whereby all resolution elements in the uncertainty domain are analyzed and a posteriori probabilities (AV) of the presence of a signal in them with a certain delay value are found during the first stage and during the second - resolution elements are analyzed once again in the descending AV order is modified. Statistical indicators of Posner's modified method whereby only the resolution elements which correspond to the most probable wide-band signal delay times are analyzed during stage 2, are examined. The efficiency of these procedures is estimated by the minimum mean search time criterion. Given an optimal selection of the search procedure, Posner's algorithm with truncation and one detection step makes it possible to shorten the mean search time by 1.8 times; the use of an additional detection step in stage 2 shortens the mean search duration by one and a half times compared to the cyclical search which involves three detection stages. References 5: 3 Russian, 2 Western; figures 3.

Superwide-Band Microwave Antenna

917K0228F Moscow RADIOTEKHNIKA in Russian No 1, Jan 91 pp 66-68

[Article by V. A. Kolobov, G. A. Polukhin]

UDC 621.396.67

[Abstract] Due to the difficulty of developing the excitation circuit and analysis methods of superwide-band microwave (SVCh) TEM-wave antennas made of symmetric diverging metal plates of variable width whose electrodynamic characteristics are poorly known, relationships are derived for calculating geometric parameters and experimentally investigating the radiation pattern (DN) and standing wave ratio (KSV) of a prototype superwideband microwave antenna designed on the basis of a TEM-wave antenna, a convex dielectric lens, and a gradual balancing junction between a coaxial line and two-wire circuit. The resulting antenna has a hyperbolic dependence of frequency on beamwidth and a mean standing wave ratio which does not exceed 1.5 within a frequency band with a span ratio of 10. The use of this antenna as a reflector antenna feed makes it possible to attain a constant reflector antenna beamwidth within a wide frequency band. References 4; figures 4.

Energy Characteristics of Aperture Antennas Radiating Nonharmonic Waves

917K0228G Moscow RADIOTEKHNIKA in Russian No 1, Jan 91 pp 68-71

[Article by N. V. Zernov, G. V. Merkulov]

UDC 621.396.67

[Abstract] Antennas' directive gain (KND) is usually determined only in the steady-state harmonic oscillation mode; the dependence of the KND energy characteristics of aperture antennas on the shape and duration of the radiated signal is examined in the article. An expression is derived for determining the directive gain of aperture antennas which radiate nonharmonic signals. Antenna directive gain is defined and directive gain formulas for aperture antennas emitting certain types of radio signals are cited. It is shown that in calculating the directive gain of antennas radiating signals with a broad spectral range of $\Delta\omega/\Delta\omega_0$ close to unity, it is expedient to take into account the dependence of directive gain not only on the antenna dimensions but also on the signal shape and duration. References 2; figures 1.

Effect of Isophase Pedestal on Phased Antenna Array Radar Characteristics

917K0228H Moscow RADIOTEKHNIKA in Russian No 1, Jan 91 pp 74-75

[Article by A. A. Abramov, M. S. Chernyakov]

UDC 621.396.96

[Abstract] The efficiency of moving target indication (SDTs) devices in radar (RLS) with a randomized phased antenna array (FAR) is investigated. The use of isophase pedestals - an efficient means of decreasing the effect of the limited phase shifter capacity of phased antenna arrays on the accuracy of determining angular coordinates based on randomizing discreteness errors and smoothing measurement results for phase error distribution in the phased antenna array aperture - is discussed. An estimate of the decrease in the MTI device efficiency of radar systems with discretely phased arrays in the case where an isophase pedestal is added to increase the angular coordinate measurement accuracy is obtained. The estimate shows that for systems with high alternate period compensation (ChPK) requirements, the introduction of the isophase pedestal is not very suitable. MTI characteristics may be improved somewhat by shortening the switching interval and smoothing phase errors. In this case the modulation component power in the spectrum within the legitimate signal band decreases noticeably. Calculations show that the attendant signal quality degradation on the matched filter output is rather small, so the only penalty is a substantial stiffening of the phased antenna array beam control speed requirements. References 4; figures 1.

Maximum Directive Gain of Cylindrical Helix Antennas

917K0228I Moscow RADIOTEKHNIKA in Russian No 1, Jan 91 pp 85-86

[Article by A. I. Samusenko, B. A. Prigoda]

UDC 621.396.677.45

[Abstract] Recommendations are given for selecting the parameter of cylindrical helix antennas which ensure the maximum radiation directivity. The dependence of the antenna's directive gain (KND) on the helix angle and

number of turns are derived; it is shown that a certain angle corresponds to an optimal number of turns at which the directive gain is at the maximum. The maximum division section for satisfactory computation accuracy is determined and a method resulting in a CPU time decrease is realized. Calculations show that the analytical directive gain convergence is ensured only when the conductor is divided into sections with $\Delta_n < 0.25\lambda$. Uniform conductor division into 0.25λ sections makes it possible to use piecewise sine curves to approximate both traveling and standing waves. It is shown that the results may be used to select initial parameters of cylindrical helix antennas which ensure the maximum gain within a given radiation sector. References 7: 6 Russian, 1 Western; figures 2.

General Premises of Fiber Optic Transmission Line Circuit Operation

917K0224A Moscow VESTNIK SVYAZI in Russian No 1, Jan 91 pp 34-36

[Article by N. N. Artyukhin, R. M. Sharafutdinov, N. N. Yakovenko, Moscow Telecommunication Institute]

[Abstract] General operating principles of fiber optic transmission line (VOSP) circuits are outlined. To operate digital line sections (TsLT) of fiber optic transmission lines successfully, maintenance personnel must know methods of measuring optical fiber (OV) attenuation and locating faults. In particular, the backscattering, insertion loss, substitution, backscattered radiation, and transmitted/backscattered radiation ratio methods are used to measure attenuation while reflectometer-based flaw detectors are used to locate faults. In addition, methods suggested by British Telecom and Mark Telephone Product for locating optical fiber faults are discussed. Figures 2.

Simplex Couplers For Microwave Transmission Lines

917K0224B Moscow VESTNIK SVYAZI in Russian No 1, Jan 91 pp 37-38

[Article by K. A. Tortbayev, Leningrad Railroad Engineers Institute]

[Abstract] Several coupler setup methods developed and implemented for decreasing the cost of erection and assembly operations are described. The methods address the problem of designing microwave communication lines (RRL) for providing television (TV) programs to remote inaccessible areas and for meeting demands of population of small railroad stations and junctions. It is shown that to this end, simplex radio relay line couplers may be employed, particularly for feeding republican, local, and oblast TV programs allowing for linguistic peculiarities of a given region. One of the method involves intercepting the signals of a trunk microwave line (MRRL) in the directional radiation zone which is determined by the beamwidth of MRRL's transmitting antenna directional pattern (DN). It is also possible to set up simplex couplers by tapping a proportion of microwave power directly from the MRRL repeater transmitting antenna aperture by

using a refractive lens, a standard antenna, or a coaxial-waveguide junction together with a microwave (SVCh) amplifier. Figures 2.

Switching-Distribution Equipment Room Gear

917K0224C Moscow VESTNIK SVYAZI in Russian No 1, Jan 91 pp 49-52

[Article by A. Yunak, POR-10 Regional Laboratory, Irkutsk]

[Abstract] The switching and distribution facility (KRA) equipment has been in operation at POR-10 since 1987. It is intended for switching channels carrying radio broadcasting programs from various sources, i.e., long-distance and local broadcasting equipment facilities, receiving radio station, etc., and distributing these programs to users, i.e., radio broadcast transmitters, rediffusion centers, etc. The switching and distribution facility consists of an input device rack, a program selector, line amplifiers, and a control panel. Rack components, principal specifications of the switching and distribution facility equipment, and its functioning are described in detail. The KRA's high reliability, simplicity, and maintenance convenience made it possible to decrease operating costs and service staff stress. Figures 3; tables 1.

Object Localization in Visual Situation Images

917K0217A Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 90 pp 3-7

[Article by V. A. Gorokhovatskiy, Yu. N. Yeresko, Ye. P. Putyanin, V. I. Strelchenko, Kharkov]

UDC 519.24

[Abstract] The development of fast algorithms for localizing objects in images with a complex background on the basis of using the hierarchic approach is discussed. As a result, a hierarchical algorithm for locating objects in images as proposed. The algorithm makes it possible to localize objects against a complex background in the presence of processing time constraints. A specific algorithm realization is described and the results of experiments to examine its performance and noise immunity are cited. It is established that the algorithm makes it possible to solve practical problems of image analysis and is characterized by high reliability and response speed indicators. Experiments were carried out in a multicomputer image processing system consisting of a microprocessor TV image input/output system and SM-4 and YeS-1050 computers. References 6.

High-Speed Dedicated Processor for Statistical Image Processing

917K0217B Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 90 pp 26-31

[Article by V. V. Bachurin, V. Ya. Budtsev, A. Yu. Bulgakov, A. N. Kasperovich, Novosibirsk]

UDC 681.325.5.01

[Abstract] Data on the development of a dedicated processor which ensures signal processing at the maximum

frequency of the processed event occurrence - 75 MHz - for the purpose of real time signal processing in order to plot bar charts of analog random signal distribution laws or to determine mean random signals are presented. The dedicated processor is assembled from original equipment operating together with an IBM PC/AT microcomputer (PEVM) and makes it possible to handle an analyzed sample volume of 10^{12} events. It is confirmed that the statistical processor has a high output and makes it possible to store and analyze large samples. The dedicated processor has been tested and is currently in pilot operation. It is air cooled and its power demand is on the order of 200 W. Its software is written in the Turbo Pascal V5.0 language; its modules are made of series 1500 chips. References 3: 2 Russian, 1 Western; figures 2.

On Signal Reconstruction and Superresolution

917K0217C Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 90 pp 31-38

[Article by B. A. Kravtsov, R. F. Minenkova, Krasnoyarsk]

UDC 621.391:53.08

[Abstract] Signal reconstruction - a classical problem formulated more than a century ago by Rayleigh - is addressed. Today's increased interest in this subject is attributed to the emergence of a number of new and prospective theoretical methods. The problem of reconstruction is formulated here in a particular case of a linear device. Application aspects of the analytical extrapolation formula first suggested by L.A. Ayzenberg are discussed and the constructive nature of this approach to the reconstruction problem is shown. Principal concepts are illustrated by a computational experiment. Principal signal reconstruction algorithms, i.e., methods of *a posteriori* equalization of the distortion added to the signal during its measurements due to its contact with the physical instrument (without which the measurement per se is impossible), are considered. The problem of reconstructing the initial signal on the instrument input from the distorted output signal and instrument characteristics is solved. The sphere of the spectrum extrapolation method applicability is determined and the results of superresolution simulation on a computer (EVM) are cited. The execution time on an SM-4 computer using the optimizing Pascal-2 software is 20 min. References 10: 9 Russian, 1 Western; figures 5.

Synthesis of Interference Optical Coats

917K0217D Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 90 pp 49-54

[Article by Ye. G. Stolov]

UDC 535.345.6

[Abstract] Ways of increasing the speed of a new method of numerically solving a system of transcendental nonlinear equations developed for solving nonlinear equations containing a complex superposition of functions which makes it possible to search for solutions of nonlinear equations on a grid formed from points by the exhaustive search technique are presented. The method is necessary for developing the theory of synthesizing coats with given optical properties. It is shown that the method makes it possible, while solving each specific problem, to store data which may be used to solve other problems and, while solving problems of synthesis, to use the accumulated data to ensure a speed several times greater than that of the original method. In addition, data banks recorded on optical media make it possible to use computer image input/output systems in searching for the solution. References 8: 7 Russian, 1 Western; tables 1.

On Photodiode and Two Operational Amplifier-Based Photodetectors

917K0217E Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 90 pp 55-61

[Article by Ye. I. Chernov, Ryazan]

UDC 681.3.04/05

[Abstract] The results of theoretical and experimental studies of new photodetectors (FPU) executed as symmetric (FPU_s) and asymmetric (FPU_a) photodiode (FD) circuits on the inputs of two operational amplifiers (OU), i.e., the OU-FD-OU photodetectors, are cited. The proposed photodetector is free of the considerable temperature errors and low signal to noise ratio of traditional designs. Due to the improvements which result in better accuracy characteristics, the photodiode may be used in photorecording equipment for a broad range of purposes. The dynamics of FDU operation are analyzed, its photocurrent gain is determined, and time responses of both types of FDU's to a jump-like photocurrent change are established. It is shown that the experimental results are consistent with theoretical data. References 4; figures 4; tables 1.

Two-Channel Wide-Band Signal Recorder

917K0217F Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 90 pp 77-81

[Article by A. N. Kasperovich, Yu. V. Shalaginov, Novosibirsk]

UDC 621.325

[Abstract] The development of a two-channel analog-to-digital converter (ATsP)-storage (ZU) module capable of solving the problem of increasing the sampling rate and expanding the frequency range for recording megahertz band signals with the help of microprocessor-based ATsP's with digital memory is described. An analysis and development of sampling and storage devices (UVKh) for the higher rate is summarized. Due to a lack of commercial domestic IC's, the problem of developing such devices using digital components is formulated. In so doing, it is found that switch control by a nontransformer principle allowing for the dependence of the control pulse amplitude on the sampling rate change is expedient. It is shown that in order to increase the sampling rate of the two-channel ATsP with a buffer storage, it is possible to employ parallel operation of several ATsP's with a time shift. To ensure

such an operating condition, an UVKh with a bandwidth of up to 300 MHz and a sampling rate of up to 75 MHz in one ATsP channel is used. Characteristics of ATsP and UVKh operation with high-frequency signals are considered. References 6: 5 Russian, 1 Western; figures 4; tables 1.

Nonlinear Digital Signal Filtering Algorithms for Electric Prospecting

917K0217G Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 90 pp 88-91

[Article by S. V. Baydikov, N. S. Ivanov, A. V. Levchenko, A. I. Chelovechkov, Sverdlovsk]

UDC 621.317.3:550.837.81.08

[Abstract] Efficient signal processing algorithms necessitated by the accuracy and noise immunity requirements of electric prospecting equipment are summarized. Various processing algorithms are checked by computer simulation in the case of abnormal interference with both symmetric and skewed densities of distribution. In the former case the abnormal interference is represented by random numbers with normal distribution and in the latter, the magnitudes of said numbers are taken. A constant signal is used as the legitimate signal for simulation. The results were processed statistically. The standard deviation of estimates as well as the maximum observed estimate deviation (peak-to-peak value) relative to the initial signal valuated for this initial signal at fixed samples are used as the algorithm efficiency indicator. The results of both field tests and simulation show that the paired comparison method looks somewhat more preferable than the median method although a final conclusion would be premature; more fields tests are required. Both methods are more noise-immune than the arithmetic mean method. References 5; figures 2; tables 1.

Factors Determining Energy Losses During Light Reflection From Dielectric Mirrors

917K0217H Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 90 pp 95-98

[Article by Yu. V. Troitskiy, Novosibirsk]

UDC 535.345

[Abstract] The physical origin and localization of losses in multilayer dielectric coats are summarized. The present paper which is a continuation of a report in *Optika i spektroskopiya* No. 1, 1990 examines in detail the effect of absorption on a reflector which is a 19-layer mirror intended for a Fabry-Perot interferometer used in the visible spectrum. The reflector consists of dielectric layers with complex refractive indices on a substrate with a given refractive index. Boundary losses on layer boundaries are also considered. It is shown that volume and boundary (equal for all boundaries) absorption affects the spectral response of a typical wide-band mirror almost identically. Loss simulation with the help of conducting surfaces whereby a weight is allocated to each boundary makes it possible to take into account the boundary "inequality"; for example, in the case of scattering by means of roughness we can take into account the layer-by-layer change in this parameter if scattering is known. It is also demonstrated that in order to

explain the measurement data in the specific example described, the loss mechanism which depends little on the wavelength must also be taken into account; diffraction of light due to a small number of large particles "contaminating" the mirror surface can be used as such a mechanism. References 6: 4 Russian, 2 Western; figures 3.

Using Amplitude-Phase Relations in Object Image Recovery Problem

917K0217I Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 90 pp 99-103

[Article by G. A. Akimova, V. V. Mataybayev, Yu. P. Syrykh, A. F. Frolov, Moscow]

UDC 535.317.1

[Abstract] Various methods of reconstructing the image of an object by its diffraction pattern, i.e., the amplitude of its spatial spectrum, are addressed. The possibility of reconstructing the image in the case where the object field is described by a complex function is demonstrated. Two cases of phase distribution of the object field magnitude which correspond to diffuse and specular reflecting objects are identified. In the former case the object is described by a real function modulated by a random phase distribution. A modified procedure based on jointly using bivariate amplitude-phase relations and iteration algorithm is used to examine the possibility of reconstruction. The recovery procedure consists of computing the amplitude-phase distribution using amplitude-phase relations and determining the initial approximation for the iteration procedure. The results show that the method demonstrates the possibility of reconstructing the image of objects described by complex-valued functions by the amplitude of their spatial spectrum without employing *a priori* data on the object itself. References 9: 6 Russian, 3 Western; figures 4.

Micropower Amplitude-to-Code Converter With Broad Dynamic Range

917K0220A Moscow TEORIYA I TEKHNIKA EKSPERIMENTA in Russian No 6, Nov-Dec 90 pp 84-86

[Article by D. M. Podorozhnyy, I. V. Yashin, Nuclear Physics Research Institute at the Moscow State University]

UDC 621.3.087.92

[Abstract] A linear amplitude-to-code converter which consists of an analog-to-digital converter (ATsP) and an analyzed subband selector which generates the operating subband code is used in order to reduce the processing word length in examining high-energy cosmic rays. The selector ensures the code indication of one of the four operating subbands. The amplitude-to-code converter contains four sampling and storage devices (UVKh), a four-channel multiplexer, a successive approximation ATsP with an external generator and a comparator, and a time control pulse generator. It is intended for operating with linear amplifiers with 1,000:100:10:1 gain ratios. The amplifiers must have a linear response within the 0.1-10 V positive output pulse range. The device ensures a relative

accuracy of digital pulse amplitude representation of ≤ 5 percent within a 10^4 input signal range if ten digits are used. The total converter power demand is 65 mW. The conversion cycle is 600 μs and the maximum clock pulse frequency for stable operation is 250 kHz; it is possible to shorten the conversion cycle to 250 μs. References 4; figures 1; tables 1.

Generators of Trains of Nanosecond Pulses on High-Speed ECL Chips

[Article by M. D. Kontorov, A. A. Maksimchuk, V. I. Mogilin, V. Yu. Smerdov, Smolensk Branch of the Moscow Energy Institute]

UDC 621.382

[Abstract] A pulse train generator executed on K1500LM102 subnanosecond emitter-coupled logic (ECL) chips is described. The generator consists of a controlled self-excited oscillator, a controlled *RS* flip-flop, and buffer elements. A delayed-feedback multivibrator in which a coaxial cable section serves as the delay element is used as the controlled self-excited oscillator. The pulse repetition period on the multivibrator output depends on the signal propagation delays in the cable and integrated circuit gates. Such generators are capable of ensuring a maximum pulse repetition frequency in the train of up to 400 MHz with high stability. Studies show that up to a frequency of 250 MHz, pulses with a normalized logical drop of 0.75 V are formed on the multivibrator output; as frequency is increased (by means by decreasing the cable length), the pulse amplitude decreases and reaches 0.5 V at a 410 MHz frequency. A subsequent pulse frequency increase leads to an oscillation quenching. The relative self-excited oscillator frequency change in this circuit due to various destabilizing factors is 10^{-4}. References 3; figures 6.

Nanosecond Phase π-Modulator With Switch

[Article by A. R. Korsunov, A. M. Tishenko, N. Ya. Pelishok, Ukrainian Polytechnic Institute at Kharkov]

UDC 621.372.837

[Abstract] A multifunction integrated device for controlling a signal on a carrier frequency with 1.5-2.0 dB transmission losses is considered. For illustration, the operation of a *p-i-n*-diode control switch circuit is described. The modulator has a phase control accuracy of +/-5° at a 0,π quantization step within a 15 percent frequency band, a blanking level of 70 to 80 dB, and a switching time of 1.5-2.0 ns. The control circuit response speed was tested using a 2A522A diode-based four-stage switch. A commercial ferrite circulator is used as the directing device. The use of the ferrite circulator makes it possible sharply to increase the attainable blanking level of the π-modulator. In this case the favorable transformation

of the electromagnetic wave propagating in the asymmetric stripline rather than the circulator's isolating properties are responsible for such an effect. References 8; figures 3.

Using Diode With S-Shaped Voltage-Current Characteristic to Generate Nanosecond Pulses

[Article by V. V. Ludikov, V. K. Chevokin, A. M. Prokhorov, O. P. Tolbanov, S. S. Khludkov, General Physics Institute at the USSR Academy of Sciences, Moscow]

UDC 621.374.24

[Abstract] The use of diodes with an S-shaped volt-ampere characteristic for generating high-voltage pulses of /g400 V with a leading and trailing edge of <600 ps necessary for developing time-analyzing optoelectronic chambers and cameras operating in the frame photography mode is discussed. The diode's operating principle is based on using the negative incremental resistance section of the return branch of the volt-ampere characteristic which separates two states - high and low resistance. The switching voltage reaches 1 kV and the residual voltage is several dozen volts. The S-diode connection diagram of the "Kadr-S" single-frame optoelectronic camera control circuit is cited. The resulting frame duration was 300 ps. Today, a control circuit optically triggered by a semiconductor laser is being developed on the basis of the S-diode. References 8: 6 Russian, 2 Western; figures 3.

Kadr-S Single-Frame Optoelectronic Camera

[Article by V. V. Ludikov, A. M. Prokhorov, V. K. Chevokin, V. P. Beguchev, S. A. Botnev, I. A. Fonareva, General Physics Institute at the USSR Academy of Sciences, Moscow]

UDC 621.383.9

[Abstract] A single-frame optronic camera with a subnanosecond exposure was developed by the authors on the basis of a biplanar image converter (EOP). The results of the camera development and dynamic testing are cited. The EOP consists of a photocathode, a microchannel plate (MKP), and a luminescent screen on a fiber optic disc with a 20 mm operating field. In the static mode the EOP has a spatial resolution of 25 line pairs per millimeter. The advantages of biplanar EOP's are the large image field, the absence of spatial distortions, and a low control voltage (hundreds of volts). A minimum frame exposure of 350 ps was attained. No nonlinear effects related to the pulse propagation on the photocathode surface were observed during the minimum exposure measurements. Tests also show that the use of an amplifier with a microchannel plate makes it possible to operate at low photocurrents and

avoid a drop in the spatial resolution due to the space charge generation. References 9: 4 Russian, 5 Western; figures 3.

Thermal Electron Emission Infrared Image Detector

[Article by V. P. Beguchev, A. M. Mechetin, D. S. Sokolov, N. D. Chernenko, N. A. Shakhramanyan]

UDC 621.383.8:621.384.3

[Abstract] A relatively cheap and simple infrared (IK) image detector of high-level signals and its design are described. The detector consists of an image converter (EOP) whose Ag-O-Cs photocathode is applied to a thermal target made of a several micrometer-thick mica plate attached to a kovar ring; the target's role is to convert a thermal relief into electronic. The target is blackened on the side facing the input window. A 10-20 μm mica plate is used as an input window with a 70 percent transmission in the 2-15 μm wavelength band. The EOP with the target was connected to an image converter amplifier whose screen was connected to a charge-coupled device array; the resulting signal was display on a video monitor (VKU). A thermal focus target produced by the detector at room temperature is presented. At the detection threshold, a 5K temperature drop in a 600K thermal field was recorded whereby the spatial resolution was ≥ 8-10 mm^{-1}, an after-image of 0.2 s, and a sensitivity threshold of $\leq 10^{-6}$ W/cm^2. References 6: 5 Russian, 1 Western; figures 3.

Direct Observation of Magnetic Flux Irregularities Near High-T$_c$ Superconductors

[Article by A. I. Belyayeva, S. V. Voytsenya, V. A. Sirenko, V. P. Yuryev, Engineering Physics Institute of Low Temperatures at the Ukrainian Academy of Sciences, Kharkov]

UDC 536.581.3

[Abstract] A magnetooptical high resolution technique for visualizing the magnetic flux distribution near High-T$_c$ superconductors (VTSP) within a broad (300-4.2K) temperature and magnetic flux (0-25 kOe) range is described. A bismuth-containing iron garnet film with the necessary Q-factor within a broad temperature range at a micrometer thickness was used as the magnetooptical indicator. Specific features of the magnetic field interaction with VTSP samples are examined and their structural defects are identified by analyzing visual patterns; the following important macroscopic parameters are determined: critical temperature, the temperature dependence of the lower critical field, and the trapped magnetic flux density distribution. It is shown that the above technique is capable of visualizing the processes of magnetic flux penetration, trapping, and emergence from the sample as well as obtaining detailed quantitative flux distribution topograms; as a result, the method may be used for proximate analysis of VTSP materials. It resolution approaches 1 μm. References 6: 4 Russian, 2 Western; figures 2.

Combined Focus and Track Analysis Error Transducer

[Article by A. V. Irlin, A. M. Kostruba, V. V. Petrov, V. G. Tsukanov, Consumer Electronics Research Institute, Lvov, Data Recording Problems Institute at the Ukrainian Academy of Sciences, Kiev]

UDC 681.84

[Abstract] Characteristics of a combined system for tracking focus and track on the basis of a multipad sectional photodetector are examined and compared to those of other devices. A comparative analysis is carried out allowing for known systems in order to estimate the advantages of the system under study. Discrimination characteristics (DKh) of the automatic focus tracking system are determined as a function of its parameters and optimal relationships between them and parameters which determine the transducer and optical disc (OD) configuration are established. The scalar diffraction theory is used to describe the interaction of focused laser radiation and the relief-conveying optical disc surface. The study shows that normal track analysis transducer operation requires the following ratio between the track and focusing spot parameters: a track height of $h=\lambda/8h+\lambda l/4n$ and a spot radius (track halfwidth) of $d=0.6\rho$. References 6: 4 Russian; 2 Western; figures 6; tables 1.

New Functional Dependence Diagnostics Method in Class of Standard Physical Approximations

[Article by A. N. Zyuganov, A. M. Ivanov, S.V. Svechnikov, Semiconductors Institute at the Ukrainian Academy of Sciences, Kiev]

UDC 519.65

[Abstract] A new method of differentially diagnosing numeric data in the following standard physical approximation class is proposed and metrologically substantiated: power, exponential, exponential-power, logarithmic, harmonic, hyperbolic, and other functions. These functions are characterized by the body of differential equations with constant coefficients, linear equations, or equations reducible to linear form. These differential diagnostics methods make it possible successfully to solve the following theoretical analysis problems: objectively identify functional dependence domains which correspond to the realization of various physical mechanisms, functioning conditions of the subjects of inquiry, and adequacy conditions of their models; determine numeric values of approximations parameters; and develop physical and mathematical models of subjects of inquiry on the basis of the proposed processing of available numeric data. References 11; figures 3.

On One Maintenance Strategy

[Article by A. I. Pereguda, Nuclear Power Institute, Obninsk]

UDC 681.326

[Abstract] The functioning of a recoverable system used in a continuous mode whose maintenance is carried out according to a given life allowing for periodic check results is considered. The system's time between failures is a random quantity with a given distribution function. It is assumed that an "aging" distribution function exists. System functioning quality indicator relations and their optimization are considered. A mathematical preventive maintenance model is constructed. An analysis of the resulting data shows that the method of developing the mathematical model makes it possible simultaneously to take into account both preventive maintenance according to a given service life and periodic serviceability checks as well as find optimum conditions for said measures. References 8.

Plotting Correct Difference Procedure for Numerical Simulation of Thermoelectric Processes in Semiconductors

[Article by M. G. Leybovich, A. M. Shilov, Tallinn Electrical Engineering Institute]

UDC 539.293.011.25

[Abstract] A semiconductor thermal balance equation is derived on the basis of Boltzmann's kinetic equation and issues of designing a difference procedure for this equation are addressed. It is shown that correct description of processes in doped semiconductors call for simultaneously solving a combined system of Boltzmann's integrodifferential equations for electrons, holes, and phonons. Due to considerable mathematical difficulties, only Boltzmann's equations for electrons and holes are considered while luminous phenomena are ignored. Expressions are proposed for approximating current densities with the help of the integrointerpolation method. An implicit iteration difference procedure for the thermal balance equation is cited. It is demonstrated that Boltzmann's rate equation can be used to derive thermal balance equations for a doped semiconductor with extrinsic conduction. References 6: 3 Russian, 3 Western.

Using Digital Protection, Instrumentation, and Optoelectronics in High-Voltage and Superhigh-Voltage Device Technology

[Article by M. Gorzhak, Czech and Slovak Federal Republic]

UDC 621.311.001.5

[Abstract] The problems of using digital protection in high-voltage and superhigh-voltage switch gear, their design and functions, and main advantages over electromechanical protection devices are analyzed; additional advantages from using microprocessors in protection systems are considered. The outlook for future development of instrumentation and optoelectronics in secondary circuits of high-voltage and superhigh-voltage switch gear is examined. A new gradient-index optical fiber being developed in the Czech and Slovak Federal Republic for the 820 nm wavelength with a signal attenuation below 5 dB is described. It is shown that the development and expansion of optoelectronic system networks in the power industry calls for developing the following instrumentation and hardware: optical power meters, optical fiber welding machines, nonhomogeneous optical fiber fault locators, and various auxiliary equipment for optical fiber splicing. References: 5 Western; figures 1.

Parametric Analog Logic Elements

[Article by Yu. P. Nikitin, Kherson Agricultural Institute]

UDC 621.372:538.56

[Abstract] Lines with distributed nonlinear capacitance for developing high-speed logic elements for computers, instrumentation, and electronics are considered. The use of blanked varicap's p-n-junction capacitance in the low-level signal operation for performing the functions of high-speed high-frequency parametric analog logic elements is discussed. The use of a shorted section of a two-wire line with distributed capacitance without losses for this purpose is described. It is shown that above parametric analog elements can be developed on the basis of such lines. A circuit equivalent of the line is calculated and the results of its experimental investigation are cited. The aforementioned high-frequency parametric analog logic elements intended for operations with harmonic signals have a rather simple design, operate within a broad frequency band, have a high response speed, and may find uses in radio electronics. References 2; figures 3.

Using Huygens-Kirchhoff Principle to Identify Electromagnetic Field in Spherical Coordinates

[Article by V. Ya. Lavrov, A. V. Kirpanev, A. P. Pukhanov, Leningrad Avionics Institute and Scientific Center of the Leninets Production Association]

UDC [537.811:519.87] 001.24

[Abstract] A method of developing an analytical model for identifying external electromagnetic fields of complex sources on the basis of the Huygens-Kirchhoff vector

principle is considered; in the so doing, the field is interpreted through the tangential components of the electric and magnetic field vectors on a closed surface which separates the field sources from the ambient area. Analytical expressions are derived for the vector components in spherical coordinates in a general case and in the case of a considerable distance from field sources. It is demonstrated that for identifying fields in a general case, it is necessary to examine the distribution of tangential electric and magnetic vectors on the basal surface while in the case of remote sources - only the electric field vector. The method makes it possible to use computers at the concluding phase of analytical data processing. References 7.

Simulating Conducting Structure Formation Process on Thin Dielectric Conductor Coat Surface

917K0233B Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 6, Nov-Dec 90 pp 27-32

[Article by I. V. Medvedev, G. A. Chechko, V. I. Panchuk, A. N. Mironchuk, I. M. Smirnov, Cybernetics Institute at the Ukrainian Academy of Sciences, Kiev]

UDC 537.534

[Abstract] The development of structures by directional deposition of metallic components of a rarefied gaseous mixture on the surface of a thin dielectric layer on a planar conductor is considered. The integrated circuit features are directly written under the effect of an intense electrostatic field developed by opposite charges in the tip - dielectric layer - planar conductor system. The first of the two electrodes for direct writing has a slightly conical lateral surface which gradually changes into a rounded tip; the second is the conductor board with a thin dielectric film. The potential distribution on the dielectric film surface is analyzed. Optimal values of the potential difference at which the necessary metallic track feature width can be obtained without decreasing the stylus tip rounding radius are derived. References 7: 2 Russian, 5 Western; figures 4.

Electromagnetic Moment of Superfine-Vacuum Linear Induction Motor With Hollow Rolling Rotor

917K0233C Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 6, Nov-Dec 90 pp 55-60

[Article by V. I. Polevskiy, Novosibirsk Electrical Engineering Institute]

UDC 621.313.001.024

[Abstract] The design of traveling modular robots which operate under extremal conditions of a superfine vacuum in the absence of liquid lubricants or grease, are exposed to degassing heating, and are subject to very stringent residual gas content requirements is considered; many of such robots are using special linear induction motors (LAD) with a rolling rotor making it possible to supply translational and rotary motion in objects. An approximate analytic method of designing a superfine-vacuum linear induction motor with a hollow rolling rotor is developed by means of using the principle of analog circuit approximation of orthotropic media on the basis of *E-H* two-ports. The motor's electromagnetic moment is found from differential characteristics of the electromagnetic

fields allowing for the operating gap irregularity and slip variations in the rotor's active section. It is shown that the above approximate method is convenient for designing and analyzing special-purpose electric motors with a rolling secondary section and an irregular operating gap. References 4; figures 4.

Examining Operating and Thermal Parameters of Stator Core Fastening Elements in Powerful Nuclear Power Plant Turbine-Driven Generator

917K0233D Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 6, Nov-Dec 90 pp 60-65

[Article by O. S. Golodnova, I. A. Yevtushenko, G. M. Fedorenko, A. A. Yantsov, Nuclear Power Plant Research Institute, Moscow and Electrodynamic Institute at the Ukrainian Academy of Sciences, Kiev]

UDC 621.313.321

[Abstract] Thermal and operating condition factors affecting the stator core fastener parameters are examined. The results of experimental studies of the heating of stay ribs of 220 MVA nuclear power plant (AES) turbogenerators running at an elevated voltage are presented. The elevated voltage operation leads to an increased stator and stay rib heating and rib expansion. Based on data on the power plant automatic control system (ASUTP), mean statistical values of the generator parameters in a steady-state operation are analyzed. The effect of the stay rib heating irregularity related to load control on thermal and mechanical conditions of the turbogenerator stator core is also analyzed. It is shown that the areas of stay ribs located near end blades of the stator core with temperature maxima in hot gas sections are the most thermally stressed. Moreover, the core stay rib heating level is greatly affected by the turbogenerator operation at an elevated winding voltage. References 3; figures 3; tables 3.

Random-Order Derivative Calculation Automation in Power Industry Installation Design

917K0233E Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 6, Nov-Dec 90 pp 89-93

[Article by A. V. Kirilenko, V. G. Levitskiy, V. V. Runkovich, Electrodynamic Institute at the Ukrainian Academy of Sciences, Kiev]

UDC 621.316:681.3

[Abstract] A method and algorithms for solving the problem of computing random-order derivatives in the course of designing power industry entities are considered. The suggested procedure makes it possible to automate the process even in the case where the entity or its elements are described by complicated analytical relations. One of the method's advantages is that it maintains the same accuracy as the direct differentiation method. The method is basedon representing the initial function by a sequence of elementary functions. The proposed algorithms were realized as a software package for a microcomputer (EhVM) intended for designing input signal restoration units of voltage or current transducers for recording substation emergencies and other devices. References 6; tables 2.

Development of Methods of Numerical Integration in Subsystems of Computer-Aided Design of Electronic Circuits: Analytical Survey

[Article by A. I. Petrenko, doctor of technical sciences, and A. I. Tsirfa, candidate of technical sciences, Kiev Polytechnic Institute]

UDC 621.372.061.2

[Abstract] Known methods of computer-aided design of large-scale- integrated (LSI) electronic circuits using mathematical models in the form of differential equations in state variables and solving them by numerical integration are reviewed. Typical design objects being fragments of LSI electronic circuit are generally describable by a system of nonlinear algebraic-differential equations $f(dx/xt,x,t)= 0$ with $x(0)= x_0$ (x- vector of unknowns in R^N-space, nonlinear vector-function $f:R^N X R^N X R^1 \rightarrow R^N$, t- time within interval $[0,T]$. In most cases one can use models in the form of ordinary differential equations, but in some cases numerical integration of such equations is quite difficult and other ways are sought. Mathematical models of LSI circuit fragments are usually multidimensional, ultrastiff, and sparse in both space and time domains. From the standpoint of integration strategy, all methods can be classified into signal waveform relaxation methods and incremental ones. The essence of relaxation methods is splitting the system of algebraic-differential equations into coupled subsystems separately integrable over the entire time interval and then solving those, usuually by either Gauss-Seidel or Gauss-Jacobi iteration. Incremental methods involve stepwise integration, linear multistep schemes and especially implicit ones being preferable to partitioning, Runge-Kutta, and composite schemes as well as to use of second derivatives because they require fewer computations on each time subinterval. Most popular are implicit linear multistep schemes based on the formula $(dx/dt)_{n+1}= \alpha x_{n+1}/h_{n+1} - S_n (x_n,x_{n-1},...,x_{n-p+1})/h_{n+1}$, where S_n:p-ple product $R^N X R^N X...X R^N$ denotes the vector-function selected for a given scheme and coefficient α_{0n} depends on the length of the time subinterval (x_{n+1}- value of vector x on (n+1)-th time step, $h_{n+1}= t_{n+1}- t_n$). Such schemes, with automatic selection of n and α_{0n}, involve a system of nonlinear equations $F_n(x_{n+1})= 0$ on each integration step, where vector-function $(F_n:R^N \rightarrow R^N$ is the one obtained by inserting this expression for x_{n+1} into that system of algebraic-differential equations. Both automatic selection and Newton's iteration procedures are being modified for a more computer-efficient design and performance analysis of electronic circuits operating in the dynamic mode, another way being to solve the system of linear equations on each iteration by retaining the LU-expansion of a sparse matrix such as the Jacobian for several successive time subintervals. While linear multistep methods are being improved, other methods are being developed and refined as alternatives. These include varistep integration, of special interest being such an integration based on the latency concept. Composite

methods involve use of different algorithms for different stages of numerical integration, which is helpful in implicit schemes and not so in explicit ones, or for different parts of the fragment structure in either explicit or implicit schemes where the vector of variables contains only a few stiff components whose determination requires a stable calculation process. References 71.

Regularized Methods of Differentiating Noisy Signals in Real Time

[Article by S. T. Tikhonchuk, candidate of technical sciences, Odessa Polytechnic Institute]

UDC 517.22

[Abstract] Approximate stable differentiation of noisy continuous signals in real time on the basis of Tikhonov's regularization principle is demonstrated on a signal $y_\delta(t)= y(t) + t$, where η denotes a stationary random process with limited spectral density and zero expectation value, y_δ being some known approximation of y(t). Inasmuch as direct differentiation of y_δ does not yield a correct solution, particularly in terms of stability, prior integration is considered instead. The equation $Int_0^t x_\delta(d\tau)d\tau= y_\delta$ is, according to A.M. Lenisov, replaced with the Volterra integral equation of the second kind $dx_\delta(t)+ Int_0^t x_\delta(\tau)d\tau= y_\delta(t)$. Following a Laplace transformation of both sides, to the left-hand side of the original equation are added small terms which happen to be functions of the derivatives of $x_\delta(t)$ and the order of system astatism is thus raised correspondingly. By virtue of a theorem pertaining to the dispersion of the output signal from each detector, all methods based on this algorithm have regularizing properties. Estimates of the biased error of a solution obtained by differentiation of the integral equation indicate how the value of the regularization parameter can be optimized with respect to accuracy, considering that it will largely depend on the reliability of a'priori information about the derivatives of y(t) and the dispersion of interference. References 7.

Generalized Hypermodels of Nonlinear Electronic Circuits

[Article by V. M. Nikolayenko, candidate of technical sciences, Odessa Polytechnic Institute]

UDC 621.3.012:517.43

[Abstract] Description of nonlinear electronic circuits by hypermodels on the basis of the transient response operator is demonstrated on such models whose functional-operator structures include not only time dependence but also dependence on the vector of nonelectrical design, technological, and performance parameters. The problem of forming such structures is much more difficult than for linear electronic circuits and, therefore, solving it requires

the use of frequency representation besides frequency functions, general functions, or polynomial representation. With the vector of transient response operators formulated accordingly, the method of frequency representation is shown to involve successive transformations. As a specific example is considered a function generator of periodic signal, an equivalent hypermodel of it being constructed for computer-aided design and shown to be adequate for nonlinear electronic circuits operating in the dynamic mode. References 11.

Model of Controllable States With Simulation of Events for Testing Automatic Technological-Process Control Systems

[Article by V. V. Galkin, candidate of Technical sciences, Kiev Engineering Office for Design of Automatic Control Systems]

UDC 519.686

[Abstract] A model of controllable states which simulates events for testing automatic technological-process control systems is described, a model which simulates not only the states of an object and, most importantly changes of its state, but also feedbacks in the control system. The choice of computer and its operating system satisfies all requirements pertaining not only to basic functions of the model and to the test procedure but also to display and storage of simulation and reference data. This is achieved by directly interfacing the model to the tested control system through hardware which couples the latter to the control object, by stringent specification of variable parameters for each element to be simulated and for the model as a whole, and by a large data volume consisting of 384 input variables and 1360 output variables. It is also possible to substantially increase the information content of the model, to adapt the model to different addresses or other control object parameters, to change variables according to the given transfer functions or the operator's special needs, and to change the state of the control object within a given time interval, all this in the process of testing. The model has been designed to simulate a multiparametric control object for testing automatic technological-process control systems on a minicomputer or microcomputer base with special means of data acquisition from transducers which convert physical quantities into electric signals characterizing not the control object itself but rather its state or, more precisely, changes of its state. The software, SIMUS (ESMCS= Events Simulating Model of Controllable States) programs written for an SM 1420 minicomputer, functions in the RSX-11M/PLUS configuration. Figures 4; references 5. references 5.

Principles of Organizing Expert System for Diagnostic Testing of Computer Equipment

[Article by V. A. Gulyayev, doctor of technical sciences, and S. A. Smyslova, post-graduate student, Institute of Modeling Problems in Power Engineering, UkSSR Academy of Sciences, Kiev]

UDC 681.326

[Abstract] An expert system for diagnostic testing of microprocessor is organized, considering that a microprocessor system is a dynamic one characterized by time-dependent as well as logic and electrical parameters. As test object, a microprocessor is described by a synergetic model of the general form $\Sigma = (S,\Phi)$, S denoting the states of its elements o_j in set O (j= 1,...,k) and Φ denoting the set of synergetic effects producible by matched synergism of elements o_j in set O. Failure to detect faults can be estimated according to this model on the basis of synergetic effects at the various levels of object description $\Phi_{11},\Phi_2,....,\Phi_{iz},...$, on the basis of states and structural bonds $S_1,S_2,...,S_j,...$, on the basis of "synergetic effect - state" pairs $[\Phi_{11}, S_1],[\Phi_{12},S_2],...,[\Phi_{iz}, S_j]$ denotes kinds of synergetic effects) or, for more compact information bits θ in sampling-for-decision time τ, on the basis of any of the invariants $I(\Phi_{11}^{\theta,\tau},\Phi_{21}^{\theta,\tau},...,\Phi_{iz}^{\theta,\tau},...)$, $I(S_1^{\theta,\tau},S_2^{\theta,\tau},...,S_j^{\theta,\tau},...)$ or $I(\Phi_1^{\theta,\tau}, \Phi_2^{\theta,\tau},...,\Phi_z^{\theta,\tau}, ...)$ or $I(\Phi_{iz}^{\theta,\tau},S_j^{\theta,\tau})$. The diagnostic testing process is then organized according to the poll theory, using heterogeneous questionnaires. The structure of such an "expert - microprocessor" facility consists of a knowledge base, an output mechanism for data(symptom)-controlled search and target(hypothesis)-controlled search in the events space, an interpretation subsystem, and an expert-user interface. The hardware includes a Standard System 1840 personal computer, a composite digital analyzer with an adapter for logic analysis, signature analysis, or combined logic-signature analysis, a current analyzer for fault location, a d.c. voltmeter-ammeter-ohmmeter kit, and instruments for contactless measurement of voltage rise and current rise without breaking into printed-circuit board. References 5.

New Book by V. A. Barinov and S. A. Sovalov on Modern Theory and Practice of Mathematical Modeling for Operational Control of Complex Electric Power Systems

[Review by G. L. Baranov]

[Abstract] The monograph "Power System Operating Modes: Analysis and Control" by V.A. Barinov and S.A. Sovalov deals with theory and practice of mathematical modeling as they apply to electrically symmetric operating modes of electric power systems and their control by the Automatic System of Dispatcher Control in the USSR Unified Power System. It analyzes steady-state performance, static and dynamic stability, operational control under normal and fault conditions, and effectiveness of protective automation on the basis of generalized mathematical models. It does not include, however, a comparative evaluation of various programs available for solving the automatic control problem by different methods. Much attention is paid to the modeling process and the need to the ensure equivalence in reduction of multidimensional systems of equations, especially of those describing unobservable aspects of the power system. Most extensively and

thoroughly are treated steady-state and static stability analysis of heterogeneous multicomponent power systems. Modern algebraic methods are applied to solution of conventional power engineering problems, modal analysis yielding complex solutions to linearized equations for subsequent synthesis of controllable electric power systems with required dynamic characteristics. In accordance with this theory of modal analysis, moreover, it is shown to be possible not only to select the most effective modern means of raising system stability but also to determine the optimum locations of regulators and to stipulate their performance in the feedback mode. Practical application of this theory in combination with modern mathematical methods is demonstrated on adaptive, self-adaptive, and optimal controls involving estimation of the system state with the aid of calculation schemes which take into account the changeability of load and demand curves. The book covers the material comprehensively and in a systematic manner. It does, indeed, sum up the contributions made by many researchers and designers to ensure a viable and highly reliable USSR Unified Power System. It is written for scientists, engineers, and students alike. Publisher: Energoatomizdat (1990).

Estimating Early Damage Stages in High-Temperature Electrical Steel

[Article by B. I. Volkov, A. L. Fedorov, YuzhVTI]

UDC 621.31

[Abstract] The use of nondestructive testing methods for identifying the degree to which microdefects affect metal is analyzed; the analysis shows that the eddy current method is most suitable for this purpose. It is applicable for precise laboratory studies of the metal condition and proximate evaluation directly in the generating equipment at operating power plants without complex and cumbersome surface preparations. The results of a study aimed at finding optimal design and operating conditions of an eddy current transducer used for identifying early metal damage stages are cited. A design and test technique which realize the possibility of detecting early stages of damage in high-temperature steel for electric power-generating equipment operating under creep flow conditions by the eddy current method are described. A portable flaw detector is developed. The detector has been commercially implemented and made available to personnel at the Razdan power plant. References 4; figures 3.

Strategy for Overhauling Rural Electric Networks up to 1,000 V

[Article by V. V. Zorin, V. V. Tislenko, A.Z. Krushelnitskiy, Khaddad Bassam, Kiev Polytechnic Institute and Ukrainian Branch of Selenergoproyekt]

UDC 621.31

[Abstract] An approach to overhauling under 1,000 V agricultural power systems on the basis of judiciously combining formal and informal procedures is developed. A numerical example corroborating the efficacy of this approach is cited. It is shown that while the problem of selecting an optimal strategy for overhauling and expanding distributed 0.38/0/22 kV power systems in rural areas is too complicated, under existing conditions this problem may be solved by judiciously combining various procedures. Allowing for today's state of computer technology, it is expedient to solve this problem in the form of interactive or expert systems making it possible to use strict optimization methods as well as designer knowledge, experience, and intuition in the best way. The efficacy of the solution may be further improved by switching to multicriterial procedures which take into account quantitative and qualitative indicators as well as the information uncertainty in the framework of the unified CAD/CAM system. References 2; figures 4; tables 1.

Diagnosing Line Insulation Condition Using 'Filin-3' Optoelectronic Flaw Detector

[Article by L. S. Nerush, Zaporozhye Central PES]

UDC 621.31

[Abstract] A new method of diagnosing the state of overhead line insulators with the help of the Filin-3 [owl] flaw detector developed by Siberian Scientific Research Institute of Power Engineering is described. The night-vision device consists of an input objective lens, an output eyepiece, an image converter (EOP), and a high-voltage source; a Krona-VTs battery or a 7xD0.1 cell are used as a primary voltage source. The flaw detector is very small and weighs 23 kg; it can detect partial surface discharges on the insulator surface. One of the new diagnostic method's advantages is the possibility of remote inspection of insulation without disconnecting the power line and its sufficient accuracy; its shortcomings include the lack of a carrying strap, of lighting for recording the inspection results, and of a second eyepiece for decreasing eye fatigue.

Experience of Reconditioning TDG 65000/150 Transformer Insulation

[Article by V. A. Taran, Dneproenergoremont]

UDC 621.31

[Abstract] The experience of rebuilding the TDG 65000/150 transformer insulation by using a new procedure is demonstrated. The procedure is capable of efficiently removing oxidation products and moisture from solid insulation. The step-by-step insulation reconditioning technique is described in detail. One reconditioning cycle lasts 120 h; a total of four cycles is necessary for reconditioning the TDG 65000/150 transformer insulation. After four cycles, the insulation resistance and dielectric loss tangent at the same temperature are equal to 220 mΩ [sic] and 0.9[5], respectively, and its moisture content is less than 1 percent.

Analyzing Utilization Efficiency of Energy Resources in Power System

[Article by B. V. Yakovlev, N. N. Bulakh, V. I. Trutayev, Belorussian Branch of the All-Union Power Industry Research and Design Institute]

UDC 662.6/9:620.9.003

[Abstract] Basic premises of analyzing the efficiency of energy resource utilization in a power system are presented. The energy balance of the power generating industry is used as an analytical tool. The block diagram of

the power system's energy balance is presented for three categories of electrical installations - condensation power plants (KES), thermal power plants (TES), and regional heating boiler units (RK). The end products of the power balance which in addition to fuel and energy resources takes into account the flows of fuel consumption, electric power from outside sources, auxiliary power needs, and energy resource losses during heat and electric power generation and transmission are the flows of heat and electric energy consumed by users on the basis of an existing rate structure. The most comprehensive and objective estimate of the energy resource utilization in the national economy is made by analyzing the fuel and energy balance (TEB) of the country as a whole and its regions (republics, rayons, and krays). The analysis demonstrates that energy resource utilization efficiency factors are 37 percent for electric power and 80 percent for heat power. These relatively high indicators are attained due to the following factors: a high proportion of modern generating units with high and superhigh steam conditions; a high proportion of thermal power plants; and a high proportion of high-quality fuel - fuel oil and natural gas - in the fuel balance. Figures 1; tables 1.

Restoration of High-Voltage Electron Beam Furnace Power Supply Sources

[Article by A. M. Turevskiy, A. I. Khudaykulov, S. B. Izmaylov, Tashkent Construction and Adjustment Directorate of the "Tsvetmetelektroproyekt" State Design Institute]

UDC 621.311.6:621.365.91:537.533

[Abstract] The advantages and shortcomings of the imported 200 kW $S15/40i$ mercury vapor thyratron-based DC power supply sources for the EMO-200 electron beam furnace used for the high-temperature smelting of refractory metals are discussed. Due to a shortage of imported thyratrons and a lack of their domestic analogues, designers at the Uzbek integrated refractory and nonferrous metal works developed a high-voltage thyristor-based DC source on the basis of commercial domestic components which contains transformerless RN-630 voltage regulators, reactors, an ATPM transformer, and a protection and alarm system. Experience of pilot operation of OKB 1181 and EMO-200 furnaces with the new power source is summarized and its advantages and shortcomings are described. References 4; figures 2.

Photoelectric Relay for Protecting Factory Assembled Switch Gear and Outdoor KRU From Open Electric Arcs

[Article by V. L. Vaynshteyn, B. A. Survillo, Mosenergo]

UDC [621.318.58:621.311.172].001.3

[Abstract] The simplified design of arc protection of factory assembled indoor (KRU) and outdoor switch gear (KRUN) with the help of the "Molniya-2" photorelays is described. The relay is triggered by the flash of light which accompanies the open arc. The protection device consists of automation units, photoresistors, and a special power supply unit. The operating principle of automation units and other components is described in detail. The total relay actuation time is a sum of the power supply make time of no more than 0.1 s and the automation unit operate time of no more than 0.05 s. The relay functions within a temperature range of -40 to +40°C. It is characterized by an increased reliability and noise immunity and is also suitable for different switch gear designs. The relay is simple to maintain, requires virtually no adjustment and servicing, contains no scarce components, and is practically feasible. Relay prototypes have passed commercial tests. Figures 1.

On Electric Pulse Method of Demolishing Old Foundations

[Article by P. I. Tsarenko, V. N. Gaponov, A. I. Polishchuk, Electric Hydraulics Design Office at the Ukrainian Academy of Sciences and Mosenergospetsremont]

[Abstract] The article is reprinted from *Energetik* No. 6, June 1990. The new Bazalt-2 electric hydraulic unit developed by the special design office of electrical hydraulic equipment at the Ukrainian Academy of Sciences for demolishing concrete and reinforced concrete foundations of powerful turbines at thermal power plants is described and its specifications are cited. The unit's specific power demand is 0.5-0.7 kWh/m^3, its power/weight ratio is 33 J/kg, and its concrete-adjusted output is 0.5-3 m^3/h. It has been commercially produced since 1985. High-voltage pulses applied to concrete separate lumps weighing 20-200 kg or more; in the case of reinforced concrete, the lumps do not fall off but are held by reinforcement rods and must therefore be removed by jack hammers. If mixtures initiating electric discharge are injected into foundation cracks and holes, the unit's output increases to 6-8 m^3/h. The special design office provides technical support in implementing the units and starting and adjusting them on a contractual basis. References 1; tables 1.

Programmed Current Pulse Source for Electroplating Bath Power Supply

[Article by V. I. Kaptanovskiy, B. M. Balashov, V. A. Zabludovskiy, N. A. Kostin, T. Ya. Yeremenko, Dnepropetrovsk Railroad Engineers Institute]

UDC 621.311.6:621.317.729.1

[Abstract] A continuation of the article "High current pulse generator for electroplating bath power supply" in *Promyshlennaya energetika* No. 8, August 1986. The development of new commercial static converters for the electroplating bath electrolyzer power supply source is summarized. The converter's power section consists of a step-down three-phase transformer and a diode-thyristor

unit; secondary voltage is controllable in 1 V step within a 0-20 V range. The control circuit consists of stabilized and nonstabilized direct current power supplies, a driving pulse generator, a phase shifter, a program device, and an output stage unit. The converter's circuit diagram and timing chart are cited. The thyristor unit which operates from 380 V three-phase mains makes it possible to shorten the plating processes by two and a half-three times compared to existing units, free service personnel, improve the product quality, and reduce the electric power consumption. References 1; figures 2.

Expanding Functional Applicability of Static Electromagnetic Devices

917K0221E Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 1, Jan 91 pp 39-41

[Article by Yu. I. Zlobin, Chuvash State University, Cheboksary]

UDC 621.316.935.042

[Abstract] Static electromagnetic devices (SEU) containing a gapless core and a winding widely used as power, instrument, and welding transformers in electric circuits with difference voltage ratings are described. Studies show that applications of such static electromagnetic devices can be expanded considerably. In particular, they can be used as arc control reactors (DGR) for equalizing capacitive fault-to-earth currents in 6-35 kV circuits and as current-limiting circuit breakers with a relay response for limiting short circuit currents in power systems with any voltage. Circuit diagrams, specifications, and performance characteristics of these devices are cited. It is shown that the use of these devices also makes it possible to save structural materials and electric power. References 2; figures 6; tables 2.

On Efficacy of 660 V Voltage

917K0221F Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 1, Jan 91 pp 49-50

[Article by V. A. Kozlov]

UDC 621.311.4.015.027.4

[Abstract] In his letter, Mr. Kozlov discusses the efficacy of using 600 volts in electric power supply systems of industrial enterprises in the light of the scarcity of nonferrous metals necessary for making conductors for such voltages. He specifically addresses the issues raised by L.M. Zeltsburg in *Promyshlennaya energetika* No. 8, August 1989, B.R. Gendelman in *Promyshlennaya energetika* No. 5, May 1987, and A.N. Zeyliger and A.N. Kuznetsov in *Izvestiya AN SSSR: Energetika i transport* No. 3, March 1983. It is shown that in estimating technical and economic indicators of 660 V lines, local conditions as well as cost factors of drives (motors) and converters used in the production process must be taken into account. These factors depend on voltage and taken together, may significantly affect total electric power supply system indicators. Issues of 660 V system safety and manpower requirements are addressed. References 3.

Expert Systems for Power Engineering

917K0226A Moscow ELEKTRICHESTVO in Russian No 1, Jan 91 pp 1-6

[Article by Yu. Ya. Lyubarskiy, V. M. Nadtochiy, R. S. Rabinovich, V. G. Ornov, M. G. Portnoy]

UDC 621.31:62-503.55.001.6

[Abstract] Various aspects of using expert systems in power engineering are addressed. Information systems (AS) used in power engineering are divided into automatic dispatcher control systems (ASDU), simulator systems, automatic process control systems (ASUTP), etc. They are further divided into formal models and expert systems. The functions of expert systems (ES) and their algorithms are considered. In particular, the MIMIR instrumental expert system (small information model of intelligent decisions), on-line switching simulator, and expert system for on-line query processing (ESORZ) and electric motor and generator diagnostic systems are examined. The use of IBM PC, XT, and AT microcomputers in expert systems is described. It is shown that expert systems are a promising means for solving many practical problems in the power industry. Special requirements imposed on ES's and their architecture and functioning by the specific features of the industry are analyzed. The MIMIR system suitability system for many practical applications is demonstrated. A conclusion is drawn that efforts of designers must be focused on synthesizing ES's with specific parameters, expanding ES applications, and developing ES hardware. References 6: 5 Russian, 1 Western.

Effect of Fault Currents With Slowly Decaying DC Components on Electrical Equipment

917K0226B Moscow ELEKTRICHESTVO in Russian No 1, Jan 91 pp 25-29

[Article by N. V. Shilin, All-Union Scientific Research Institute of Electrical Power Engineering]

UDC 621.31.014.38.001.6

[Abstract] Existing Soviet standards GOST 687-78 for general alternating current circuit breakers and new IEC requirements for "High Voltage AC Circuit Breakers" (document IEC 56) are reviewed. The effect of slowly decaying DC components in the short-circuit current which aggravate operating conditions of circuit breakers by complicating the arc extinguishing due to a delay in the current zero crossing and amplify thermal and especially electrodynamic effects on the circuit breaker and other equipment, such as transformers, switches, etc., is analyzed. Recommendations are developed for standardizing transient recoverable voltage of generator circuit breakers. It is suggested that switches and circuit breakers be tested twice: in a static condition and during a short circuit. It is shown that in order to check whether domestic generating station circuit breakers meet specifications, GOST 687-78 must be expanded to include additional methods and testing techniques; moreover, after a review by experts the

standards must be submitted to the IEC "Switching Equipment" subcommittee 17A. References 9: 5 Russian, 4 Western; figures 6; tables 2.

Taking Into Account Human Body Mass Distribution Law in Developing Electrical Safety Standards

917K0226C Moscow ELEKTRICHESTVO in Russian No 1, Jan 91 pp 35-39

[Article by Ye. B. Sokolov, All-Union Agricultural Electricification Institute]

UDC 62-784.37:519.25.001.24

[Abstract] The issue of standardizing the impact of electrical currents passing through the human body and their effect on fibrillation is addressed. Fibrillation threshold currents are examined in order to develop the maximum permissible safety levels. In so doing, the distribution of the human body mass is taken into account. As a result, permissible current levels have an electric shock probability much lower than that currently used in standards. In addition, current norms for adults exposed to industrial electrical unit accidents can be increased. For example, for a 50 kg adult body, currents with a normal shock probability of 0.0014 have a shock probability of 3.7 times lower after the mass distribution law has been taken into account, i.e., 0.376×10^{-3}. References 11: 8 Russian, 3 Western; figures 1; tables 4.

Lightning Protection Simulation of Transmission Lines With Straddling Supports

917K0226D Moscow ELEKTRICHESTVO in Russian No 1, Jan 91 pp 54-58

[Article by G. N. Aleksandrov, G. V. Podporkin, Yu. S. Shevchenko, Leningrad]

UDC 621.315.1:621.316.98.001.6

[Abstract] Vulnerability characteristics of compact transmission line wires are determined in a laboratory using large-scale models with a 10 m long spark simulating the lightning leader; according to the authors, this reflects most closely real conditions of lightning strikes at grounded installations. Studies were carried out in an outdoor test bench developed by the superhigh voltage lab at the Leningrad Polytechnic Institute (LPI). The results of studies on a model of a 500 kV transmission line at positive shielding angles are consistent with data on the operating experience of these lines; this fact confirms the suitability of the technique selected for simulating the process of lightning strike at the line. An examination of lightning protection of compact lines with straddling supports shows that within a real transverse dimension range, outer wires are not stricken by the stroke, i.e., are protected rather reliably. The vulnerability to lightning strikes of compact power lines with straddling supports is less than that of traditional power lines by approximately two orders of magnitude. Furthermore, the probability of the lightning reaching the wires decreases sharply when the elevation of the earth wire over the live wire increases and drops when when the distance between the earth wires is shortened. References 11; 9 Russian; 2 Western; figures 4; tables 4.

Electric Breakdown Initiation Across Long Gap by Laser

917K0226E Moscow ELEKTRICHESTVO in Russian No 1, Jan 91 pp 59-61

[Article by L. M. Vasilyak, S. P. Vetchinin, D. N. Polyakov]

UDC 537.523.4:621.375.8.001.6

[Abstract] The results of an investigation of the possibility to develop a laser-initiated breakdown across a 1 m-long gap at 1 MV in the case where optical breakdown plasma nuclei are sufficiently far from each other and there is a layer of undisturbed air with normal density between them are presented. The gap breakdown was initiated by the leader mechanism whereby several plasma nuclei were present in the corona area. It is shown that by developing inside the discharge gap a long laser spark, one can increase the electric discharge length and control its path in space. Depending on the number of nucleation sites of laser plasma, its principal effect is shaped by different processes. The conditions which lead to the development of a quasicylindrical channel with a reduced gas density and a sufficiently high electron concentration are identified. References 8: 7 Russian, 1 Western; figures 3.

On Grounding Metal Cable Sheathing Under Magnetic Effect of Aerial Power Lines

917K0226F Moscow ELEKTRICHESTVO in Russian No 1, Jan 91 pp 63-66

[Article by L. D. Razumov]

UDC 621.315.2.053.1.001.24

[Abstract] The need for intermediate grounding equipment for metal cable sheathing with an external insulating hose under the magnetic effect of aerial transmission lines is examined. It is shown that in areas where high-voltage transmission lines come close to cables inside insulating hoses with a metal sheathing without grounding, the magnetic effect of overhead lines may become reinforced due to a current drop in the metal sheathing and the attendant deterioration of its shielding action; this is especially severe in the case where the affected section is located in the middle between power line substations. In addition to grounding metal sheathing at repeaters and terminal offices, intermediate points in cables with an insulating hose must also be grounded in sections exposed to high-voltage power lines; this grounding must be spaced by no more than 2-2.5 km and have a resistance not exceeding 5 Ω. References 2; figures 3; tables 1.

External Magnetic Field Shielding in Superconducting Unipolar Machine's End Sections

917K0226G Moscow ELEKTRICHESTVO in Russian No 1, Jan 91 pp 75-77

[Article by N. P. Gotovtsev, M. I. Fedosov, D. V. Chechurin, Leningrad]

Power Engineering

UDC (621.313.291:537.312.62).001.24

[Abstract] Two methods of shielding the external magnetic field in end sections of unipolar superconducting machines (SPUM) in order to decrease the leakage field are considered: installing a massive ferromagnetic shields or shielding coils in the machine's end sections in the cryostat's warm zone (between the shaft and the cryostat); and installing in these end sections superconducting shields. The results show that it is expedient to make the shielding coils from nonsuperconducting but highly conducting material; the efficiency of using coils made from a nonsuperconducting but highly conducting material with a certain cooling type or massive ferromagnetic screens depends on the specific SPUM design and purpose. It is recommended that in optimizing the parameters of the shielding coils in SPUM end sections, the method of penalty functions be used; this makes it possible to determine the motion direction toward the optimum allowing for the constraints imposed on the design parameter variation domain. References 6; figures 3; tables 1.

Silicon Sheet Steel in Russia

917K0226H Moscow ELEKTRICHESTVO in Russian No 1, Jan 91 pp 82-84

[Article by Yu. N. Starodubtsev]

UDC 669.14.018.583 (091)

[Abstract] The history of the development of electrical sheet steel, i.e., an alloy of iron with silicon, since the last century is examined. It is shown that W.F. Barrett, W. Brown, and R.A. Hadfield were the first to examine its magnetic and electrical properties. Various published sources dating back to 1896 are reviewed. It is shown that prior to WWI, almost all sheet steel for Russian electrical engineering enterprises was imported, primarily from Germany. In 1918 electrical sheet steel production ceased altogether for economic reasons. In 1921 the issue of producing silicon sheet steel in Russia was raised at the 8th All-Russia Electrical Engineering Congress which approved specifications for electrical sheet steel. Various measures taken in Russia to improve the quality and increase the output of silicon sheet steel between 1921 and 1931 are discussed. References 28: 25 Russian, 3 Western.

Indicators of Energy Production by Power Systems and Units in First Half of 1990

917K0204A Moscow ELEKTRICHESKIYE STANTSII in Russian No 1, Jan 91 pp 2-3

[Article by Yu. Yu. Shtromberg, engineer, I. A. Terentyev, engineer, and V.M. Danilin, engineer, State All-Union Trust for Technical Administration of Power System Management]

UDC 621.31.004

[Abstract] Energy production during the first half of 1991 was characterized by stability under stressful conditions with respect to power balance, affecting especially the regions of Northern Caucasus and Transcaucasia as well as both Chita and Buryat Power Systems. Altogether 871.6 billion kwh of energy was produced during the first six months of 1990, with 494 power units of 150-1200 MW capacity in operation. Most serious failures occurred in the Ulan-Ude thermal electric power plant and in the Gusinoye Ozero (Goose Lake) GRES of the Buryat power system. The reliability of all power units, except that of the 500 MW units in the Ekibastuz GRES-1 state regional electric power plant, was on the same level as that of power units with the same ratings in other countries, the low reliability of those 500 MW power units being attributable to inadequate equipment maintenance. The average specific fuel consumption in thermal electric power plants operated by the USSR Ministry of Energy and Electrification rose by a factor of 0.4 to 320.8 g/kW.h, because production of electricity increased more (by 2.0 percent) than than the production of heat (by 1.6 percent). Among electric power plants running on natural gas or fuel oil, the specific fuel consumption was lowest in the Sredne-Uralskaya (Central Ural) GRES with 300 MW power units (310.7 g/kWh), in the Kostroma thermal electric power plant with 300 MW power units (315.6 g/kWh), in the Karmana GRES with 300 MW power units (319.5 g/kWh), and in the Surgut GRES-2 with 800 MW power units (315.0 g/kWh). Among power plants running on coal, the specific fuel consumption was lowest in the Reftin GRES with 300 MW power units (330.4 g/kWh) and 500 MW power units (325.9 g/kWh) and in the Belovo GRES with 200 MW power units (337.3 g/kWh). The specific fuel consumption was highest in the Tbilisi GRES with 150 MW power units (471.5 g/kWh) and in the Novocherkassk GRES with 300 MW power units (401.7 g/kWh). In some electric power plants there is evidently not much of an effort made to utilize available means of making the power generating equipment operate more economically. Tables 2.

Problems of Evaluating Labor Economics in Determining Cost Effectiveness of Electric Power Plants

917K0204B Moscow ELEKTRICHESKIYE STANTSII in Russian No 1, Jan 91 pp 10-14

[Article by A. A. Zarnadze, candidate of economic sciences, Moscow Institute of Management imeni S. Ordzonikidze, and V. S. Serkov, candidate of technical sciences, All-Union Institute of Power Engineering and Economics]

UDC 621.31:331.024.2.004.18

[Abstract] A cost analysis of electric power plants is undertaken which emphasizes consideration of labor scarcity in calculation of economic as well as technical parameters as the basis for design and construction of new such power plants. The three main premises which may lead to selection of labor-intense variants are: 1) labor cost in terms of wages is lower than material and investment costs so that the role labor economics is being underemphasized; 2) depreciation cost is high, because equipment is being replaced rather than repaired on account of the large amount of heavy manual labor needed for overhaul in lack of adequate mechanization and automation; 3) large labor savings can be realized in the technology of construction and installation. A comparative overall cost analysis is

needed which takes into account both profitability and present worth of incremental investment as well as that, according to the theory of socialist production, the productivity of societal effort increases steadily as a result of scientific and technical developments. The cost equation and the cost minimization problem are formulated accordingly for a general solution of the multivariant selection problem. As an illustrative example is considered choosing between two electric power plants on the basis of higher cost effectiveness: A) a hydroelectric power plant requiring an investment of 1,300 million rubles for construction and a crew of 1000 workers for operation so that the total annual operating cost will be 15 million, the normalized cost of this power plant thus being 173.4 million rubles; B) a thermal electric power plant requiring 750 million rubles for construction and a crew of 4000 workers for operation so that the total annual operating cost will be 75 million rubles, the normalized cost of this power plant thus being 165 million rubles. A decision in favor of power plant B will be justified only when an objective evaluation of the economics of employing 3000 workers will support it. Such an evaluation indicates, for instance, that the multiplier of investment cost should be about twice as large when it factors in labor economics in the northern regions than when it factors in labor economics in the USSR's Central European part. References 2.

Filtration of Automatically Acquired Data by Automatic Technological- Process Control Systems in Thermal Electric Power Plants and in Nuclear Power Plants

[Article by V. I. Nazarov, candidate of technical sciences, and V. P. Krupnov, candidate of technical sciences]

[Abstract] Analog data acquired by measurement made for automatic technological-process control in thermal electric power plants and in nuclear power plants are filtered for the purpose of monitoring their reliability. The filtration process is usually based either or "stiff settings" or on some quorum of parameters. Filtration in the first case is simple and readily implemented, but by a rather coarse filter. Filtration in the second case is implemented by a filter with a much narrower passband for unreliable data, but the probability of its passing unreliable data increases fast as the analyzed quorum is reduced down to two parameters only. Additional filtration is proposed for each procedure which will make them more effective, namely "extrapolating" filtration and "sliding" filtration respectively. Let the value A^{k+1}, read during the (k+1)-th 15 min time interval of a measurement period, fall into the $AL \leq A^{k+1} \leq AU$ range (AL- lower setting, AU- upper setting) and satisfy the condition $|A^{k+1}- A_{\Phi}^{k}| \leq 2 A_{\Phi}^{k}$- value of parameter A^{k+1} determined during the k-th time interval, Δ_2- permissible range of deviation) or be a element in the $|A^{k+1}- A_{\Phi}^{k}| \leq A_2^{K}$ quorum, the object of filtration being to predict the value A_{Φ}^{k+1} of parameter A. Both filtration algorithms were used for development of an analog-data

reliability monitoring subsystem of the automatic technological- process control system in thermal electric power plants. Figures 3; references 2.

Regional Tabulations of Electrical Resistivity of Soils

[Article by T. V. Verbitskaya, engineer, Yu. B. candidate of technical sciences, and Yu. V. Tselebrovskiy, doctor of technical sciences, Siberian Scientific Research Institute of Electrical Power Engineering and State Institute for Planning Oil and Gas Exploration in Tyumen Oblast]

[Abstract] The electrical resistivity of soils in the Tyumen oil and gas producing region has been measured and calculated, considering that the electrical conductivity of a soil consists of an electrolytic component and an electroosmotic one. The electrolytic component, associated with the motion of ions of salts dissolved in the soil water, depends on both the electrical resistivity and the weight fraction of the latter. The electroosmotic or "surface" component, associated with the motion of double-layer charges along the solid-liquid interface, depends on both the net charge and mobility of the diffusion part of that double layer. For arenaceous soil the dependence of its electrical resistivity on its porosity and moisture content is accounted for by parameter which lumps both factors together: $G= w\gamma/100\varepsilon$ (w- weight fraction of moisture, γ- density of sand in t/m^3, ε- porosity). The numerical data are tabulated in so as to show how the electrical resistivity $\Omega.m$ decreases with increasing moisture content (0.05-0.50: dry soil, 0.55-0.80: wet soil, 0.85-1.00: saturated soil) and decreases with increasing salt concentration over the 0.1-8.0 mg-equ./dm^3 range, assuming that the sum of anions $Ca^{2+} + Mg^{2+} + Na^+$ is equal to the sum of cations $Cl^- + SO_4^{2-} + HCO_3^-$. For validation, these data are compared with the results of control measurements made by vertical electrical probing at various locations within the given region. The mean absolute deviation is 47.2 percent. Figures 3; tables 2; references 5.

Inspection of Protective Relaying and Automatic Reclosure Equipment in 6-35 kV Electrical Distribution Networks Under Load

[Article by V. G. Glovatskiy, candidate of technical sciences, A. P. Kuznetsov, candidate of technical sciences, V. Ye. Kazanskiy, candidate of technical sciences, and Yu. A. Stepanov, engineer, State All-Union Trust for Technical Administration of Power System Management, Moscow Institute of Energetics, and Kuybyshev Regional Administration of Power System Management]

[Abstract] An apparatus has been developed for under-load inspection of protective relaying and automatic reclosure equipment, including current transformers and associated circuitry. The apparatus includes two devices for

testing relays (UPK-1K, UPK-2K) and two devices for testing current transformers (UPT-1N, UPT-1V). The first relay tester UPK-1K feeds current once at a time into the current circuits of the protective relaying system, whereupon it measures that current, the relay activation time, and the automatic reclosure activation time. It consists of a load transformer, a current regulator, a commutating switch controlled by OR logic, a starter, a time element, an ammeter, and a plain switch, also two controlled timers measuring the relay tripping time and the reclosing time respectively. The second relay tester UPK-2K checks the current relays with rectified current and a direct-action relay, without any circuit disconnections and without interference with the state of readiness. It has a rectified-current regulator with a 0-100 A range, a stopwatch, and an interlock. The two other testers UPT-1N and UPT-1V check current transformers without disconnections: the UPT-1N checks them under a nominal load current by checking a control point on their magnetization curve, the UPT-1V checks them under a small load current by checking a series of points along their current-voltage characteristic on the secondary side while the primary current is varied from one and a half times the nominal load current to full saturation of the transformer. This tester has a potentiometer from which voltage is applied through a transfer switch and a distribution voltage transformer to the secondary of the tested current transformer, that secondary having been disconnected from the relay circuits. It can also have a relay whose winding which will be connected into the secondary circuit of the tested current transformer. These devices have already been installed in the Kuybyshev regional electrical distribution networks and are performing very well. Figures 4; references 8.

Analysis of Electromagnetic Processes in A.C. Traction Drive

[Article by V. I. Anders, doctor of technical sciences, V. G. Graponov, candidate of technical sciences, and V. A. Lopatin, candidate of technical sciences, Moscow Institute of Energetics

UDC 621.331:62-83

[Abstract] A highly computer-efficient new method of analyzing the electromagnetic processes in a "polyphase induction motor - diode frequency converter" traction system under steady-state conditions is demonstrated, considering a converter which consists of a rectifier and an autonomous voltage inverter rectifier. The problem of calculating the instantaneous values of periodically varying quantities is resolved by splitting it into a preliminary analytical estimation of these values along with the system parameters and using a computer only for subsequent multivariant calculation of the system design parameters. The operation of a 3-phase induction motor is described by a set of equations satisfying the conditions of electrical balance (three equations, for the e.m.f. in each phase) and mechanical balance (equation of motion), supplemented with an equation for the electromagnetic torque

relating the electrical quantities to the mechanical quantities in the system. An analytical solution for the three phase currents is followed by a graphical-numerical analysis for the DK712A motor operating in the traction mode or as brake, an analysis which covers the entire operating frequency range of a thyristor converter. The computer time required for calculations by this method is one order of magnitude less than required by other known methods. Figures 4; references 4.

Method of Determining Leakage Permeances of Magnetic System in Synchronous Electric Machine With Salient-T Inductor Poles

[Article by D. I. Besedin, engineer, and Ye. A. Novikov, engineer, Moscow Institute of Energetics]

UDC 621.313.32.001.24

[Abstract] A method of mapping magnetic leakage fields in electric machines for calculation of its leakage permeances is demonstrated on a synchronous inductor machine with salient-T poles. It is based on the principle of "inverse" electrical mapping after both the physical model and the mathematical model have been constructed. It requires a correspondence between the electrical conductivity of the material of the model and the magnetic permeability of the material of the original in any scale held constant during measurements, which applies also to the air gap. There is, accordingly an inverse correspondence between flux and field lines in the original and in the model. Geometrical similarity of conductors must, moreover, exist wherever measurements are made. An alternator with an "inside-out" configuration is considered: a hollow cylindrical magnetic inductor core carrying toroidal field coils on the inside, around a rotor consisting of two coaxial bimetal cylinders into which ferromagnetic north-pole and south-pole pieces have been inserted, and a stator inside this rotor carrying the armature coils in slots around its periphery. For such a machine are, by the proposed method, determined the permeances of both tangential leakage and end leakage paths in the interpolar spaces, of the leakage flux paths through the excitation winding, of the leakage flux paths between the spacers under pole pieces, and of the external leakage flux path. Calculations are made according to conventional theory of electric machines, using the magnetic scalar potential and equivalent electric circuits. Figures 7; references 11.

Dynamics of Optimally Controlled Bizonal D.C. Electric Drive

[Article by A. S. Lebedev, candidate of technical sciences, Moscow Institute of Energetics]

UDC 62-83-52

[Abstract] Bizonal d.c. electric drives for machine tools with optimal control ensuring maximum response speed are considered, the dynamics of such a drive operating in

the second zone being analyzed in accordance with general theory. The two fundamental coupled equations of electrical and mechanical balance are solved for the magnetic flux in the motor and for the speed of the motor normalized to respective nominal values. A differential equation solvable by separation of variables is then obtained for the response time. The resulting exact expressions for the cases of zero and nonzero load torque respectively are shown to be most compact and applicable to any such drive. They involve transcendental functions, however, and therefore are approximated according to the method of least squares for acceleration from nominal speed up and for deceleration back to nominal speed. They are, moreover, converted to dimensionless form for graphical representation in the form of universal curves. The approximation error, over the nominal to five times nominal speed range and the zero to one fifth maximum torque range, lies within 5 percent or within only 2 percent depending on whether the magnetic flux is being weakened or boosted. Figures 2; tables 2; references 5.

Rational Design of Power Supply With Inductive Energy Storage

917K0203D Moscow ELEKTRICHESTVO in Russian No 12, Dec 90 pp 79-80

[Article by I. N. Grigoryev]

UDC 621.272.001.24

[Abstract] A method of rationally designing a power supply with inductive energy storage is outlined, inductive energy storage being preferred to capacitive energy storage because it features higher energy-to-volume ratio and can be more easily cooled. The essence of the method is optimization of a target function which involves relevant parameters of both basic power supply components, namely the charger and the energy storage: $G = w_L G_L + w_C G_C$ (G- mass/size or cost of each component, w- weight factors). The design problem is formulated as one of determining the combination of storage time constant and charger voltage or power which will minimize that target function. One can accordingly optimize the design of power supplies which combine either a high-power charger with a low-Q (high series resistance) energy storage or a high-Q (low series resistance) energy storage with a low-power charger. The method is demonstrated on a power supply which delivers energy to a full load continuously but receives energy from the charger periodically so that the charging time must be taken into account. The relative charging time $t^* = T/\tau$ (T- storing time, τ- storage time constant) can be expressed as a function of the relative voltage $V^* = V/V_0$ (V_0- voltage necessary for charging the storage when the series resistance is zero). One can invert the relation $V^* = t^*/(1 - e^{-t^*})$ and then replace it with a power-law relation, $t^* = 3[1+4(v^*-1)/3]^{1/2}]-1$ approximating it closely within 1 percent when $t^* < 2$. Figures 1; references 4.

Examining Certain Factors Limiting Wavefront Slope Data Transmitter Accuracy

[Article by I. M. Belousova, A. V. Bukanov, S. N. Leonov, A. G. Skepko]

UDC 621.373.826

[Abstract] Light beam wavefront (VF) slope angle data transmitter errors which appear in individual subapertures of Hartmann's wavefront distortion meter due to the focusing element defocusing and failure to take into account the static transfer function's (SPF) two-dimensionality which, in turn, is due to the gap between the quadrant coordinate-sensitive detector (KChP) sensors, are analyzed. It is shown that by using the nonlinear SPF segment as well as reasonable requirements for the transducer manufacturing precision and the design of its components, one can attain a light beam slope measurement range of $(0.7-0.8)\theta_d$ given a measurement accuracy on the order of single percentage points. It is also shown that in order to understand better the operating principles and accuracy of elementary wavefront slope data transmitters (EDUN), one should also examine the effect of small-scale wavefront distortions within the subaperture on its measurement accuracy and range. References 6: 5 Russian, 1 Western; figures 4.

Calculating Calibration Curves of Optical Particle Size Analyzers Allowing for Radiation Source and Photodetector Spectral Response

[Article by V. I. Ovod]

UDC 535.36:681.786

[Abstract] The results of theoretical examinations of the calibration curves of optical particle size analyzers calculated with respect to various spectral responses of the radiation source and photodetector are presented. The optical analyzer (OA) calibration curve (KKh) is defined as the dependence of the measured signal, which is proportionate to the pulsed luminous flux scattered by individual particles forced to intersect the beam and recorded by the photodetector, on the particle diameter. A technique for calculating the response signal measured in an optical particle size analyzer in polychromatic radiation is described. The calibration curve "oscillation smoothing" effect observed when polychromatic lighting is used instead of monochromatic is estimated quantitatively for the most popular analyzer design for recording small-angle scattering. A software package for analyzing the calibration curve on a computer (EVM) is developed. Practical applications of the study results and the software package make it possible to increase the analyzer accuracy by making a sound selection of the radiation source and photodetector spectral response characteristics. References 12: 11 Russian, 1 Western; figures 4.

Chromotest: New Instrument for Detecting Color Vision Anomalies

[Article by V. V. Volkov, A. V. Luizov (deceased), N. S. Fedorova, A. I. Tselomudryy]

UDC 681.784.44

[Abstract] A new device for examining color vision and detecting its anomalies developed at the State Optics Institute (GOI) imeni S.I. Vavilov is described. The effort was prompted by the physicians' need to have a reliable and simple to operate instrument for checking eyesight on a large scale and doing so with immediate recording of the examination results. The design is based on the method of determining the first color discrimination threshold whereby color discrimination thresholds between white and various hues are recorded. As a result, an achromatic area is identified on the chromaticity locus chart for each patient thus helping to determine the type and degree of the color vision defect. The optical train of the device and the testing procedure are described in detail. The device enables ophthalmologists quickly to identify the colors which the patient perceives normally and those where he experiences color perception difficulties. The test duration does not exceed five min. References 3: 2 Russian, 1 Western; figures 5.

Estimating Infrared Radiometer Calibration Error in Field Conditions

[Article by A. V. Chugunov, S. A. Fedyunina]

UDC 535.214.4.088

[Abstract] The experience of operating infrared radiometers in the field is summarized. It is shown that in calibrating the instrument immediately before taking the measurements, the temperature distribution over the surface of an extended calibration source is the most sensitive to external factors. A perfect radiator model (MAChT) made as a grooved disc with a 500 mm diameter and a black matte coat with an emissivity of at least 0.99 was used. The radiating surface temperature was monitored by platinum temperature sensitive elements located at the center, at the mid-radius position, and at the edge of the radiator. The method makes it possible to minimize accuracy losses in a given natural object radiance temperature range by selecting the calibration source temperature. The technique also makes it possible to estimate the error component of radiance temperature measurements caused by environmental factors and optimize the calibration source temperature; it is nevertheless necessary to conduct further studies using various temperature distribution models. References 6: 5 Russian, 1 Western; figures 3.

Electric Dipole Echo in OH⁻-Doped Glass at Superlow Temperatures

[Article by F. S. Vagapova, R. V. Saburova, N. S. Leshenok]

UDC 535.2+666.19

[Abstract] Electric dipole echo in quartz glass containing hydroxyl OH⁻ groups is examined theoretically. The polar impurity group in quartz glass serves as an ion; at also has an electric dipole moment which is the primary cause of the echo. The theory of electric dipole echo in quartz glass doped with hydroxyl is developed and compared to data which predict the possibility of observing additional echo responses in this system. The appearance of new echo signals as a result of radiation harmonic generation is interpreted. Echo signal observations make it possible to examine many important glass characteristics, particularly relaxation times which are determined by a decrease in spontaneous (primary) and stimulated echo signals. The appearance of "new" echo signals helps to determine asymmetry parameters since the signal strength and pulse area depend on these parameters. Energy level splitting can also be found by measuring the resonance frequency as a function of the static external field. References 12: 7 Russian; 5 Western.

Quasispherical Electromagnetic Waves in Gyrotropic Crystals With Scalar Permittivity

[Article by A. N. Godlevskaya, A. N. Serdyukov]

UDC 535.13:548.0

[Abstract] A theory of spherical waves in noncentrally symmetric crystal media with scalar permittivity is developed allowing for the substantially anisotropic natural optical activity. Electromagnetic waves in uniaxial crystals are considered at the frequency of intersection of two principal dielectric constant variance curves. Phase velocities of quasispherical electromagnetic waves in the short-range region are found. Phase velocities of waves propagating in crystals with isotropic permittivity are considered for illustration. In the long-range region, magnetic induction vectors of diverging quasispherical waves are locally transverse and circularly polarized and decrease with distance. It is shown that disappearance of the anisotropy of dielectric properties realized in a number of uniaxial crystals at the intersection frequency provides a unique opportunity to examine a number of very fine optical phenomena, including gyrotropy not masked by linear birefringence, in a pure form. References 18: 13 Russia, 5 Western; figures 2.

Recording Triple-Exposure Holographic Interferogram to Control Wave Front

[Article by V. G. Gusev]

UDC 535.317.1

[Abstract] A method of recording triple-beam interference patterns with a wave surface shift by holographic interferometry methods using diffuse scattered light is examined. The lateral wave surface shift leads to the appearance of moire fringes whose equation makes it possible to determine certain wave aberration coefficients faster and more accurately. The method of Fresnel hologram recording is used to find the conditions for obtaining such interference patterns for controlling a planar wave front without the help of a diffraction grating. Interference patterns were recorded in the course of spatial filtering in the hologram plane due to the presence of phase distortions caused by aberrations of the plane reference wave front. Since the frosted screen was illuminated by a spatially bound beam, the object field was speckle-modulated. References 6; figures 2.

Effect of Objective Correction on Illuminance Distribution During Optical Fiber Alignment by Focusing Method

[Article by L. V. Novikov]

UDC 535.3:666.189.2

[Abstract] The effect of the objective lens's wave aberrations on the illuminance distribution in the image plane and the degree of its similitude to the internal structure of single-mode optical fibers (OOV) are determined and the effect of the spherical aberration correction on this distribution is examined. It is shown that given an objective lens aperture of 0.3, the wave aberration's standard deviation for a point on the axis should not exceed 0.04λ, where $\lambda=0.589$ µm. When such objective lenses are used, the requirements for their spherical aberration correction exceed Mareschal's criterion regardless of the correction type. By taking this factor into account we can decrease the single-mode optical fiber adjustment error by selecting an objective lens with a low value of wave aberration's standard deviation σ_w. References 4: 3 Russian, 1 Western; figures 4.

Selecting Known Optical Signal Through Random Noise by System of Independent Detectors

[Article by M. I. Trifonov]

UDC 535.853.68

[Abstract] The method proposed in *Optika i spektroskopiya* Vol 66 No 5, 1989 for selecting a known optical signal against the background of random noise, also tentatively referred to as the indication representation method, is further developed. A case where the system's receiving area represents a set of independent optical radiation detectors is considered. The problem of synthesizing an optimal two-channel optoelectronic system for selecting a known optical signal through external additive Gaussian noise is analyzed. The system is synthesized from a combination of independent detectors, two adders which perform optimal linear processing of these detector's responses, and a linear analyzer. Each adder's optimal response function is determined with the help of a system of linear equations derived with respect to the ratio of receiver noise to external noise. A radial-angular, or circulant, detector representation is used in practical applications of the method. References 6; figures 2.

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